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Le Verrier

Discoverer of the New Planet &c

THE

YEAR-BOOK OF FACTS

IN

Science and Art:

EXHIBITING

THE MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS OF THE PAST YEAR,

IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.

BY JOHN TIMBS,

EDITOR OF "THE ARCANA OF SCIENCE AND ART."

Illustrated with Engravings.

"The collision of such thoughts may be compared to the agency of the Electric Telegraph, which concentrates knowledge from afar, and at once unites the extremities of kingdoms in a common circle of intelligence."—SIR R. I. MURCHISON: PROC. BRIT. ASSOCIATION, 1846.

Aphis Vastator, the supposed cause of the Potato Disease: magnified 30 times.—See p. 241.

LONDON:

DAVID BOGUE, FLEET STREET:

(LATE TILT AND BOGUE).

MDCCCXLVII.

Wilson and Ogilvy, 57, Skinner Street, Snowhill, London.

M. LE VERRIER,

(Frontispiece)

DISCOVERER OF THE NEW PLANET.

THE great discovery of the year is that of a Planet exterior to Uranus; with which, according to the Astronomer Royal, nothing in the whole history of astronomy can be compared. It has, however, become the subject of a national controversy; and this to such an extent, that we can only give the principal data.

In 1821, M. Alexis Bouvard published his table of Uranus; and a few years subsequently, it was found that the movements of the planet were not represented by them; therefore, they were not reducible to those formula which its simple position in space, and its relations to the other celestial bodies, required. In the Cambridge Observatory, and elsewhere, these anomalies were noted, and insisted on.

In 1834, Dr. Hussey requested the opinion of the Astronomer Royal upon the probability of the existence of a disturbing body exterior to Uranus; similar conjectures having been hazarded by Bouvard and Hansen. In 1837, M. E. Bouvard suggested a similar doctrine to the Astronomer Royal, who, in 1838, communicated to M. Schumacher, that the calculated distances of the planet were considerably too small. In 1844, M. Eugene Bouvard was continuing his attempts to either reconcile existing observations, or to settle the impossibility of their agreement. In the last week of October, 1845, Mr. J. C. Adams, of St. John's College, Cambridge, left at the Royal Observatory, Greenwich, for the opinion of Professor Airy, the following paper: "According to my calculations, the observed irregularities in the motion of Uranus may be accounted for by supposing the existence of an exterior planet, the mass and orbit of which are as follows:—

Mean distance (assumed nearly in accordance with Bode's law)	38.4
Mean sidereal motion in 365.¼ days	1030·9
Mean longitude, Oct. 1, 1845	323·34
Longitude of Perihelion	315·55
Eccentricity	0·1610
Mass (that of the Sun being Unity)	0·0001656."

In July 29, Professor Challis began his search for the new planet, founded on Adams's elements, and, between this time and the end of October, found no less than 3,150 stars; having actually observed the planet on August 4 and 12, and September 24.

Nov. 10, 1845, M. Le Verrier read his first paper to the French Institute on the Theory of Uranus, demonstrating that no perturbations of the old planets would account for the movements of Uranus.

June 1, 1846, M. Le Verrier gave his second paper in the Comptes Rendus, admitting no second explanation but that of a new planet, and stating its longitude to be about 325°, *i.e.*, within a degree of Mr. Adams's calculations.

August 31, M. Le Verrier read his third paper to the Academy of Sciences, with the elements of the supposed planet in detail.

On Sept. 2, Mr. Adams communicated to the Astronomer Royal a second set of elements, with a comparison between the places as observed, and those calculated from both sets.

Sept. 10, Sir John Herschel spoke of the predicted planet, before the British Association for the Advancement of Science at Southampton, in the following terms:—"We see it as Columbus saw America from the shores of Spain. Its movements have been felt trembling along the far-reaching line of our analysis, with a certainty hardly inferior to ocular demonstration."

Sept. 23, the astronomers of the Berlin Observatory, guided by the conclusions of M. Le Verrier, found the planet the first evening they looked for it.

Such is the minute history of this remarkable discovery; in which, however, there has been, on the part of the countrymen of Le Verrier, a tendency to depreciate the candour of those of Mr. Adams. Practically speaking, the honour is with M. Le Verrier. His calculations were as close as Mr. Adams's; and his directions were those by which the planet itself became visible.

We have availed ourselves of this *précis* from "the Historical Supplement to Felix Farley's Bristol Journal;" adding a few interpolations; and with corrections from an official source.

M. Le Verrier has been raised to the rank of Officer of the Legion of Honour, and M. Galle to that of Chevalier of the same Order. The report of the Minister on the subject contains this statement:

"Sire,—A great discovery—one of the rare efforts of the human mind—has conferred honour on France and on your reign. A French youth, Le Verrier, of the Academy of Sciences, by the unaided power of profound thinking, using the mathematics as its instruments, has grasped, in the regions of space beyond our solar system, a planet which, but for him, might have remained for ever undetected by observation. In general, observations have preceded science; but, in this case, science has only had to follow the steps of theory, and to look at the exact point indicated for the unknown star which theory alone had as yet seen (by the mind's eye). There has not, in the history of science, occurred any more striking event than this. It would be impossible to produce a more remarkable computation of the series assigned to our astronomical system. In recommending M. Le Verrier for the Legion of Honour, I also recommend M. Galle of Berlin, who has been the first to discover the planet Le Verrier. He thus united with M. Le Verrier in a discovery which has astonished the scientific world." M. Le Verrier has, accordingly, been raised to the rank of Officer of the Legion of Honour; and M. Galle to that of Chevalier of the same Order. Other honours await the French discoverer in his own country. The Minister of Public Instruction has informed the Principal of the College of Saint Lô—where M. Le Verrier received his literary education—that a bust of that astronomer, from some eminent chisel, will be given to the college.

At the Anniversary Meeting of the Royal Society, too, a Copley Medal was awarded to M. Le Verrier, for his discovery; and was received for him, at his request, by Sir John Herschel.

M. Le Verrier has published in the *Comptes Rendus*, many valuable papers on his researches upon comets, and upon planetary motions. In the *Connaissance des Temps* for 1843, he published an elaborate memoir upon the secular variations of the elements of the orbits of the seven principal planets. In the *Connaissance des Temps* for 1848, is a valuable paper from him, on the theory of the planet Mercury; and, just published, in the additions to the *Connaissance des Temps* for 1849, is a full account of the successive steps he followed, &c., for the discovery of the new planet.

Professor Challis has furnished to the Observatory Syndicate, at Cambridge, a Report of his exertions to discover the new planet, founded on the theoretical Calculations of Mr. Adams. We regret that we have not room to reprint this interesting document, which reflects high honour on Mr. Adams, Professor Challis, the University, and England in general.

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OF PERSONS EMINENT IN SCIENCE OR ART. 1846.

BESSEL, the celebrated astronomer.
HUGH MURRAY, geographer.
DAVID BOOTH, philologist, and writer on popular science.
DR. BOSTOCK, writer on Medical and Physical Science.
J. C. CARPUE, eminent surgeon and anatomist.
GEORGE DARLEY, illustrator of Mathematics and Astronomy.
M. HALLETTE, civil engineer.
B. R. HAYDON, historical painter.
DR. HOFFMEISTER, zoologist.
MR. SAMOUELLE, entomologist.
MR. HUME, operative chemist.
OTTO VON KOTZEBUE, the distinguished circumnavigator.
JAMES MARSH, chemist, inventor of the test for arsenic.
ADMIRAL KRUSENSTERN, the French circumnavigator.
J. ROWBOTHAM, popular writer on science.
DR. G. M. BURROWS, F.L.S.

THE

YEAR-BOOK OF FACTS.*

Mechanical and Useful Arts.

THE GREAT WESTERN RAILWAY.

EARLY in the past year there appeared a magnificent folio volume† detailing the History and Description of this Railway, profusely embellished with views of its great works, and the adjacent scenery; and forming altogether the most complete specimen of railway illustration yet achieved. Its production has involved an outlay of some fifteen hundred pounds, a large sum, it is true, but only proportionate to the vast and varied interest of the subject, and its demand on popular encouragement. To this Railway, we may add, public attention has been directed, of late, in the great question of "the Gauges;" the line presenting the majority of the extent of railway in this kingdom laid with "the Broad Gauge."

Thirteen years have now elapsed since the Great Western Line was first proposed; mainly with the object of reviving the commerce of the ancient port of Bristol, in connecting it by this iron road with the metropolis.

In choosing the course of the railway, two lines of country were

* TWENTY YEARS have elapsed since the Editor of this work commenced his Record of Science and Art, by way of abstract; and the aggregate results of his labours have been :—

	Volumes.
Arcana of Science	11
Year-Book of Facts	9
	20 Volumes.

During this long probationary course, the Editor has received from the leading critical journals the highest approval of the objects and advantages of his work; which recognition of his exertions has, from time to time, stimulated him in the improvement of this very popular design.

The earlier volumes of the *Arcana of Science* have long become scarce, or out of print. Considerably larger impressions of the *Year-books*, from 1839 to 1846, have, however, been printed; so that a small number remain on hand, for such persons as may be inclined to complete their sets, or commence the purchase of the Series.

There is one encouraging indication of the public approbation of the extended design of the YEAR-BOOKS: *the sale of each has been nearly treble that of the* ARCANA OF SCIENCE.

† The History and Description of the Great Western Railway, including its Geology, and the Antiquities of the District through which it passes; accompanied by a Plan and Section of the Railway, a Geological Map, and by numerous Views *of the principal* Viaducts, Bridges, Tunnels, Stations, and *of the Scenery and Antiquities* in its Vicinity; from Drawings taken *expressly for this Work, and* executed in Lithography, by John C. Bourne. *Folio. (Size, 26 by 14 inches.)* D. Bogue, Fleet-street, 1846.

to be considered, between London and Bristol, or rather, between Reading and Bath; the one ascending the vale of the Kennet, keeping the high ground south of the Marlborough downs, and descending through the Cotteswold by the valley of the Avon; the other following the ravine of the Thames, from Reading to near Wallingford, ascending the great vale of Berks, at the foot, and to the north of the Marlborough downs; and therefore intersecting the crest of the Cotteswold above Box, a village a few miles east of Bath.

Mr. Brunel, the appointed engineer to the Company, chose the latter line—to the north of the Marlborough downs—both as being, in an engineering point of view, the best line, and as affording, in a greater degree than any other, facilities of communication with Oxford, Gloucester, Cheltenham, South Wales, and the west of England generally; points of very great importance.

The railway traverses a great variety of formations, and terminates in the centre of a district of high geological interest. As the arrangement of the strata is on the whole uniform, the upper and newer formations being found at the eastern end, and the older cropping out or rising to the surface in regular geological succession as they approach the West, there is little difficulty in arranging the order of their description: the formations intersected by the railway extend from the London clay down to the coal-measures of the Bristol basin; and within a distance of thirty miles from that city, upon the railways that branch from it, are found all varieties of rocks, from chalk to grauwacke and trap. It would be difficult to select a line or district possessing greater geological character, and better fitted for the convenient study of the science itself. Accordingly, the chapter devoted to the "Geology" of the line, in the great work before us, is one of its most important sections.

The constructive details of the line are admirably given. First, of its Gradients. The greater part of the rise upon this line is concentrated within a comparatively short space, by means of two inclined planes, upon one of which assistant power is employed, and the remainder of the line thus left free to be more economically worked. There is but one summit level, which is 77 miles from the London end; and, consequently, within about 18 miles only from the centre of the whole line. This summit is 270 feet above the London depôt, and 292 above that at Bristol. From London the railway rises gradually to Maidenhead, Reading, and the Oxford station at Steventon, by easy gradients, nowhere exceeding four feet in the mile, or one in 1,320, and frequently under this. This is a distance of fifty-six miles, and upon it occurs the heaviest traffic. From Steventon to the Swindon summit, the line continues to rise gradually, without undulations, at a maximum inclination of eight feet in the mile, or one in 600. From the summit levil, the line descends by two inclined planes at Wootton-Basset and Box. The intermediate gradients do not exceed eight feet in the mile; the inclinations of the two planes are one in a hundred, or 52 feet in the mile. The length of the Wootton-Basset plane is one mile and 550 yards; it is surmounted without any extraordinary assistance. The Box plane is two miles and 660 yards in length, and upon

it occurs the Box tunnel, the first out of London. Upon this plane an assistant engine is employed. From Bath to Bristol, the descent is one continued gradient of four feet in the mile, or one in 1320. Thus, the whole line, (118 miles 20 chains in length,) with the exception of the inclined planes, may be regarded practically as level; and it has been so arranged that four-fifths of the traffic are carried on upon that part of the railway of which the maximum gradient does not exceed four feet in the mile.

From the latter advantage, the absence of objectionable curves, and the great proportion of passenger traffic expected upon the Great Western Railway, it was proposed at a very early period of the undertaking to travel at a higher speed than had been attained upon other railways. With a view to this end, the permanent way was peculiarly laid—principally in fixing the *gauge* or distance between the rails at seven feet, a much greater width than had hitherto been adopted, and by which it was proposed to ensure greater steadiness than was otherwise consistent with high speed.

The rails upon the great Western are what is called bridge-shaped, with wide wings, or flanges; they are laid upon continuous bearings of wood, instead of upon the interrupted support of chairs or pedestals, as usually employed in this country; and it was proposed by this means to obtain greater steadiness of motion, with less noise, and less of that wear and tear which forms a very serious objection to high speeds upon ordinary railways. The longitudinal bearings are half timbers of American yellow pine, connected together by transverse timbers. The whole frame is simply laid upon the road, which is previously covered with a bed of broken stone, burnt clay, or gravel, called technically "ballast." The main timbers are themselves canted or inclined inwards, at a slope of one in twenty; and the rail, of sixty pounds weight to the yard in length, are screwed down upon a strip of felt. The rails are almost wholly of Welsh iron, rolled at the several works of Dowlais, Ebbw-Vale, and Rhymny.

The locomotive engines in use upon the Great Western differ from those generally employed, chiefly in the dimensions of their wheels and framing, which are adapted to the broad gauge, and in the short stroke of their pistons as compared with the diameter of their driving-wheels, an arrangement intended to allow of a high rate of speed without any unfavourable increase in the motion of the parts of the machinery upon each other. All the engines run upon six wheels. In the passenger-engines the driving-wheels are seven feet in diameter, and the other wheels four feet. The length of stroke is eighteen inches, in the diameter of the stroke fifteen inches. The boiler contains 127 tubes. Each of these engines, when upon the line, and properly supplied with fuel and water, weighs about nineteen tons, and is calculated to exert a power equal to 120 horses, working at about forty-five miles in the hour. The tender following each engine runs also upon six wheels, and is constructed to contain about 1,600 gallons of water and twenty-five cwt. of coke."—(Railway Hist.) The carriages in use upon the line are not only broader than

those running upon other railways, but they are also more lofty, and are all supported upon six wheels, the diameter of which varies from four feet to four feet six inches; it being one of the incidents of the broad gauge that it permits wheels of a very much increased diameter to be used with safety.

The population on the line is estimated at 910,000; added to which is the population of West London, about 1,500,000. The income of the company for six months of 1842 was £302,084. 0*s*. 5*d*. This, however, is but an approximation to the probable returns of the railway when the continuations and branch lines are completed.

The cost of the Great Western Railway (118 miles) has been five millions and a half of money; and so rapidly were the works carried on, that between 6,000 and 7,000 persons were constantly employed upon the line.

The Great Western Railway indisputably, in respect of speed, has stood first in the world; going over 118 miles twenty chains, uninterruptedly, in less than four hours and a half!

REPORT OF THE RAILWAY GAUGE COMMISSIONERS.

The Commissioners (Sir F. H. Smith, Professor Airy, and Mr. Barlow) appointed by Royal Warrant in July, 1845, "to inquire whether, in future private bills of Parliament, provision ought to be made for an uniform gauge," made their Report in February last. Their inquiries were directed to three points: first, whether an uniform gauge should be compulsory on all future railways; secondly, whether it was possible to obviate or mitigate the evil arising from want of uniformity; thirdly, whether it is expedient or practicable to effect an uniformity in railways already constructed or in process of construction. In considering these questions, it became necessary to decide a fourth, as arising immediately out of the third: viz. which of the gauges is preferable for general purposes.

On the first point, involving the more abstract advantage of uniformity, one decision only could have been anticipated. The Commissioners considered it under the following heads:—as applying to fast trains, to ordinary trains, to goods' trains, and to the conveyance of troops. With regard to the first head, they do not think the inconvenience of a break of gauge of sufficient importance to call for legislative interference. With regard to the second and third, they pronounce the break an intolerable evil, imperatively demanding remedial measures; and with regard to the fourth, they are of opinion that it might expose the country to serious danger. On the second point, after considering in detail the various plans suggested of mingling the broad and narrow gauges by double lines of rails, or of adapting the carriages to fit either gauge by shifting wheels or placing them on trucks, they pronounce them severally to be impossible or dangerous, and arrive at the conclusion that none of them are calculated to remedy in any important degree the inconveniences attending a break of gauge. The third point, which they deem the most important, and have investigated with great minuteness, is treated in conjunction with the fourth, and is indeed merged in it.

The question of the comparative merits of the broad and narrow gauges is examined under four divisions:—safety, accommodation and convenience for passengers and goods, speed, and economy. We extract the opinions of the Commissioners:—

"1. As regards the safety, accommodation, and convenience of the pas-

sengers, no decided preference is due to either gauge; but on the broad gauge the motion is generally more easy at high velocities.

"2. In respect of speed, we consider the advantages are with the broad gauge; but we think the public safety would be endangered in employing the broad gauge much beyond their present use, except on roads more consolidated and more substantially and perfectly formed than those of the existing lines.

"3. In the commercial case of the transport of goods, we believe the narrow gauge to possess the greater convenience, and to be the more suited to the general traffic of the country.

"4. The broad gauge involves the greater outlay, and we have not been able to discover, either in the maintenance of the way, in the cost of the locomotive power, or in the other annual expenses, any adequate reduction to compensate for the additional first cost."

From these opinions, the conclusion is of course irresistible, that the narrow gauge is, on the whole, to be preferred; that its uniformity is to be imperative; and, if an alteration is to be made, it should be from the broad to the narrow. This conclusion is greatly strengthened by the fact that there are of the former only 274 miles at present in work to 1901 of the latter; and, whilst the whole cost of the one alteration, including every possible expense, would not much exceed a million of money, the capital required for the other would be incalculably greater. To adapt the broad lines to the narrow gauge would be nothing more than to approximate the rails; but to convert the narrow into the broad would be to build new bridges and new tunnels, and, in short, to reconstruct the entire road.

STATISTICS OF THE RAILWAY SYSTEM.

The European and American—in short, the general—Railway progress at the close of 1845 is thus summed up in a table, apparently of French, or rather Belgian, extraction, in the *Mining Journal.* [A kilometre is rather more than half a mile English]:—

Belgium	Kil. 559	Fr. 145,984,014
England	3,638	2,000,000,000
Holland	154	32,340,000
Germany	3,140	502,400,000
United States	7,500	846,075,000
France	986	330,000,000
Denmark	106	12,508,000
Italy	228	45,782,000
Cuba	37	7,030,000
Russia	52	14,560,000
Total .... kilometres	16,400	3,936,989,414 fr.

Thus, it is shewn, that, calculating the population of the two quarters of the globe in which railways have been introduced at 234,000,000, a capital of 19 f. 55 c. has been already expended, on the whole, for each individual. The comparative cost of construction is estimated at —for Belgium, 261,000 f.; Great Britain, 550,000 f.; Holland, 210,000 f.; Germany, 160,000 f.; United States, 113,000 f.; France, 335,000 f.; Denmark, 148,000 f.; Italy, 200,000 f.; Cuba, 190,000 f.; Russia, 280,000 f. The mean speed per hour upon several of the principal English lines is thus represented:—North Midland, and

Eastern Counties, 58 kil. (33 miles); Great Western, 53 kil. (31 miles); London and Birmingham, 43 kil. (25 miles); Manchester and Leeds, 39 kil. (24½ miles); Birmingham and Gloucester, 38 kil. (24 miles). The remarkable progress of the speed of locomotives since their introduction, of course in England, is noted thus:—In 1824, the first locomotives in England, with a 40-tons power, travelled at the rate of only 10 kil. per hour (6 miles). So great was the improvement in a few years that in 1829 the Rocket travelled at the rate of 25 kil. per hour (15 miles); in 1834, the speed of the Fire-fly was 34 kil. per hour (20 miles); in 1839, the North Star moved with a celerity of 62 kil. per hour (37 miles); and, at the present moment, locomotives have arrived at a speed of 70 kil. per hour (42 miles). During the same period (since 1825), the quantity of fuel required for the propulsion of locomotives was diminished five-sixths: that is, six tons of coal were consumed formerly for one at the present moment.

RESISTANCE TO RAILWAY TRAINS AT DIFFERENT VELOCITIES.

THE application of the dynamometer to test the Resistance of Railway Trains has led to some important, though not unanimous, results.

Mr. Scott Russell has, by the aid of Morin's dynamometer, determined the resistance at high velocities; the deductions from which differ considerably from previous theories, as the annexed table will shew:

Velocity in miles per hour.	Resistance by experiment in lbs per ton.	Resistance by formula in lbs. per ton.
8	8·0	8·7
14	12·6	13·9
29	16·5	15·7
31	23·3	25·4
32	22·5	22·7
33	22·5	22·7
34	16·6	17·3
35	22·5	22·4
36	22·5	22·5
37	17·5	18·2
39	30·0	31·6
41	22-9	19·6
45	21.7	21·0
46	23·1	23·3
47	33·7	33·1
50	32·9	36·3
51	26·4	23·0
53	41.7	42.1
61	52.6	54·8

Mr. P. W. Barlow has read to the Royal Society, a paper, with the view of obtaining a more correct knowledge than has hitherto been possessed of the resistance which the air opposes to the motion of locomotive engines at high velocities, and of the loss of force arising from increased back pressure, and the imperfect action of steam. For this purpose he institutes a comparison between the velocities actually acquired by railway trains with those which the theory of accelerated motion would have assigned; and his experiments are made not only on

trains propelled by a locomotive engine, but also on those moving on the atmospheric railway, which latter afford valuable results, inasmuch as the tractive force is not subject to the losses at high velocities necessarily incident to locomotive engines. The author finds that the tractive force of a fifteen-inch pipe is so small (being less than half that of a locomotive engine) that the time of overcoming the inertia must limit the amount of traffic on a single line, especially with numerous stations. When a great velocity is obtained, the tractive force of the locomotive is much reduced, and, therefore, a much greater velocity can be attained on an atmospheric railway. The inquiries of the author into the amount of resistance exerted by the air on railway trains, lead him to the conclusion that on the atmospheric railway the loss of tractive power of the piston from friction, &c. is very inconsiderable, and that the resistance of the air is less than had been hitherto estimated, not exceeding, on an average, ten pounds per ton on the average weight of trains. A tabular statement is then given of the results of the experiments made by the British Association for the purpose of comparison with those obtained by the author. The general conclusion whch he arrives at is, that the resistance of the air in a quiescent state is less than had been previously estimated, and that the ordinary atmospheric resistance in railway progression arises from the air being generally itself in motion, and, as the direction of the current is almost always oblique, from its producing increased friction in the carriages. This kind of resistance will not increase as the square of the velocity; and as it is the principal one, it follows that the resistance to railway trains increases in a ratio not much higher than the velocity, and that the practical limit to the speed of railway travelling is a question, not of force, but of safety.

Mr. W. Harding has communicated to the Institution of Civil Engineers, a memoir upon the above subject: the inquiry was stated to have been facilitated by the application of two novel and direct modes of measuring resistances recently afforded to engineers by the atmospheric railway apparatus and the application of Morin's dynamometer to determine the tractive force required in propelling railway trains, as used by Mr. Scott Russell in his experiments. In arranging the vast number of results afforded by experiments, the author proceeded on the following principle: he collected together all the results of experiments which exhibited uniform velocities maintained on a calm day and on a line free from sharp curves; these results he calculated and projected in diagrams, and he shewed that between these results there subsisted the most satisfactory agreement and consistency. He argued that the fact of the agreement of so many experiments made by different persons with different objects on different lines of railway during the last seven years, the resistance being measured in no less than four different ways, leads almost irresistibly to the conclusion that the *increase* of resistance with the velocity was *such as these various experiments* indicated. The result was, that *the resistance per ton to a* passenger-train of, say, thirty tons at a *speed of sixty miles per hour,* would be upwards of 50lbs. per ton, in-

stead of 18lbs. per ton—or nearly three times as much as had been estimated by some engineers. In these investigations, the dynamometer employed was so delicate as to indicate distinctly every change of gradient, and even the entering and leaving a cutting or tunnel, shewing the greater or less influence of the wind. The usual dynamometers, with helical springs and pistons working in oil, are, for such purposes, nearly useless, as they smother the results. It is stated, that the table of the force of wind at certain velocities, as given in Smeaton's reports, was erroneous by fifty per cent., and that the front and the lateral action of the air upon a train constituted a large portion of the actual resistance: it is necessary to make these corrections, which, when made, shew an extraordinary accordance between the calculated resistance, and that absolutely recorded by the instrument.

MACHINE TO REGISTER THE VELOCITY OF RAILWAY TRAINS.

A COMMUNICATION has been read to the Society of Arts, from M. Ricardo, Esq., "On a Machine to Register the Velocity of Railway Trains when in motion." Their machine consists of two parts: one receives motion from the carriage; the other by clock-work. They are arranged in the following manner:—An excentric is placed on the axle of the carriage, and gives motion, by means of a connecting rod, to a lever attached to the machine, which lever acts upon a ratchet wheel, and is so arranged that each revolution of the wheel of the carriage advances the ratchet one tooth. An endless screw is turned on the spindle of the ratchet-wheel, and gives motion to a small-toothed wheel below, and on the spindle of which is fixed what may be termed a lateral excentric (as one part projects more than the other on the side of the wheel). Against this, the short end of a horizontal lever is pressed, by means of a spring. As the excentric revolves from the projecting to the lower part, it moves the lever, and with it a pencil fixed at its other end, in one direction, till it reaches the lowest point, when, by a spring pressing upon it, it takes the opposite direction till it reaches the highest point, when it returns again. The wheels are so arranged that the excentric makes one revolution in each mile that a train travels. The clock-work is used to turn a drum, upon which a ruled paper is wound. When the train is stopping at a station, the pencil is stationary, and marks only a straight line; but when in motion, diagonal lines are drawn by the action of the lever as described. The extreme distance between the two points of the diagonal lines determines the velocity at which the train has been travelling. Thus, the train is made, by this apparatus, to keep a perfect register of the work done, which would at all times indicate the neglect of either the engineer or conductor.

RAILS AND SLEEPERS.

A PAPER has been read to the Institution of Civil Engineers by *Mr. G. W. Heamans*, describing the system invented by Sir John *MacNeill*, and employed on the Dublin and Drogheda Railway, for

preparing the transverse Sleepers, and fastening the Rails upon them. The sleepers are half baulks, 12 inches by 6 inches at the junction of the rails, and intermediately, half trees of larch, with the bark on, not less than 8 inches by 4 inches, are placed with the round side upwards at an average distance of 2 feet 6 inches apart. These sleepers are prepared for bearing the rails by fixing twelve at a time on a sliding table similar to that of a planing machine: they are moved forward by steam power beneath two circular cutters, set at the given distance of the gauge apart, and revolving very rapidly, and which pass through the whole series of sleepers, cutting, at a given inclination, the seats for the rails. A slight stoppage of the table takes place as each sleeper is cut, in order to afford time for four drills to descend simultaneously and to pierce the holes for the pins or trenails for holding down the rails. An engine of six-horse power suffices for working two of these machines, by which one thousand sleepers can be finished complete in twenty-four hours, at an expense of about one penny each, instead of twopence-halfpenny each, which they formerly cost by manual labour. The sleepers, thus prepared, are used transversely beneath rails of the bridge, from which the sides are slightly pinched inwards in finishing, so as to form a dovetail, with a joint plate with a raised rib, which is laid at each junction, and which, by using a screw-pin and plate at one end, and a collar-headed pin at the other, holds the rail very fast, preventing lateral and vertical motion, but permitting longitudinal action in expansion and contraction. These rails weigh eighty-three pounds per yard. The total cost per mile of the double line, including rails, sleepers, pins, spikes, joint-chairs, &c., laid complete, is stated at £3470. 2s. 8d., when the rails cost £7. 5s. per ton.

LOCOMOTIVE ENGINE WHEELS.

Mr. T. R. Crampton has read to the Society of Arts, a communication on the subject of large and small driving Wheels as applied to Locomotive Engines, in which he stated the following was the reason why the large wheels were, after a series of experiments made on the Great Western Railway, first decreased and afterwards increased in size, viz., that the Ajax, which was 10 feet wheels, and had a total heating surface of only 474 feet, was found not to answer; while the North Star with 7 feet wheels and 724 feet of heating surface or actual power, was found to work with efficiency. In consequence of this, the following two engines were then built: the Fire Fly with 7 feet wheels and 705 feet of actual power: and the Fury, with 6 feet wheels and 608 feet of power; after some months' working the small wheels were given up for want of power, and the larger ones, 7 feet, were generally adopted; thus clearly shewing that the size of the wheels had very little to do with the power, it being a question entirely of heating surface. He was of opinion that the ten-feet wheels would have been at work at the present time had they had the 724 feet of surface applied to them in the first instance, as well as to the seven-feet wheels.

MAMMOTH LOCOMOTIVES.

The Great Western Railway Company have completed three most powerful Locomotive Engines, built upon the plan, and under the superintendence, of Mr. Brunel, assisted by Mr. Gooch, the superintendent of the locomotive department. The dimensions of the *Great Western* engine are as follows:—Diameter of driving wheel, 8 feet; cylinder, 18 inches; stroke, 24 inches; boiler, between 15 and 16 feet; weight of engine, 36 tons, without water; weight of the tender, without either coke or water, 10 tons; making a total of 46 tons. This splendid engine, built for passenger trains, drew a train weighing 136 tons up the incline at Wootton Bassett, with as much ease and as fast as one of the smallest engines would a passenger train. The engine *Queen* is likewise for passenger trains, and was built at Swindon:—Driving wheels, 7 feet diameter; stroke, 18 inches; cylinder, 16 inches; boiler, 14 feet; weight of engine, without water, 25 tons; weight of tender, 9 tons, without coke or water. The above engines, when their machinery gets into working order, are intended to be employed in propelling the express trains. The other is a luggage engine, the *Premier*, having her six wheels of 5 feet diameter connected. The dimensions of this locomotive are in other respects similar to the Great Western passenger engine. The *Premier* is decidedly the most powerful employed on the broad gauge, surpassing in strength and speed the *Hercules* engine, which propelled 406 tons on the experimental trip with the gauge commissioners.—*Railway Standard.*

Another stupendous engine, called the *Elk*, has been built on the Great Western line. It was designed by Mr. Brunel, and built under the superintendence of Mr. Gooch: her dimensions are—driving wheels, 7 feet diameter; stroke, 18 inches; cylinder, 16 inches; boiler, 14 feet; weight of engine, without water, 25 tons; weight of tender, without coke or water, 9 tons. She was attached to an express train with six carriages, and performed a distance of 77 miles (from Swindon to Paddington) in 1 hour and 20 minutes. The down journey was not so rapid, having occupied 1 hour and 31 minutes. The *Elk* is on the same plan as the *Great Western*, the *Queen and Prince*, but on a less gigantic scale, being intended for express trains only.

TIMBER DRAWBRIDGE CARRYING THE BRIGHTON AND CHICHESTER RAILWAY ACROSS THE RIVER ARUN.

This Drawbridge, (popularly, though not very appropriately, called the Telescope Bridge,) was constructed to meet the requirements of the Lords of the Admiralty, who have the jurisdiction of the River Arun, over which the bridge is built, it being requisite that the bridge should be capable of leaving a clear space, when open, of the unusual width of sixty feet, for the passage of vessels navigating the river, which is a larger opening by many feet than any drawbridge hitherto constructed.

This bridge, with the exception of the machinery for moving it, is

constructed entirely of timber, and consists of two strongly trussed frames or platforms, one of which moves laterally, or sideways; the other, or principal trussed framing, moves back to the extent of sixty-three feet, when the bridge is opened, and occupies the space vacated by the first-mentioned moveable platform.

The principal trussed moveable framing is 144 feet long, 35 feet high, and weighs about 70 tons; it is supported by and traverses upon fourteen friction-wheels, each six feet in diameter, and is easily moved by suitable wheels and pinions, acting on a fixed rack underneath the bridge; two men and a boy readily opening the bridge in from four to five minutes.

The total length of the bridge is 273 feet, and the clear width is 12 feet; it is constructed for a single line of rails, but the railway on either side has a double line.

From the great length of the moveable timber framing, it was requisite that it should be so braced and supported, that it should not change its shape, or become depressed at the end, when moved away from its point of support on the opposite pier. This object has been effectually accomplished by means of suspending slings and adjusting screws, by the use of which latter the whole framing can always be kept in perfect adjustment, although the extreme end of the framing overhangs upwards of 60 feet from the wheels on which it moves.

The strength of the work was severely tested before the opening of the railway, both by Major-General Pasley and Col. Codrington, the Inspectors-General of Railways; two of the heaviest engines and tenders being placed upon the bridge, they expressed themselves perfectly satisfied with the result of the trial.

The bridge was designed by Mr. J. U. Rastrick, F.R.S., the Engineer-in-Chief of the line; and does credit to the careful workmanship of Mr. Butt, of Littlehampton, the contractor of the work. —*Illustrated London News*, No. 237.

NEW SUSPENSION BRIDGE FOR RAILWAY PURPOSES.

Mr. H. H. Russell, formerly an assistant of Sir Isambard Brunel in the construction of the Thames Tunnel and other public works, has patented a new mode of arranging the curves in Suspension Bridges, by means of which the vibration and oscillation of those structures are entirely neutralized, and thereby rendered available for railway purposes. The novelty of the invention consists in the arrangement of the chains, which alternately are relieved by the support which is given from the lower portion of the catenary curve; it being supported in the pier immediately under the summits or points of bearing of the upper chain, which interlaces at the centre of the span, thus distributing the weight of the moving power alternately from the higher to the lower chain. Should the principle realize the expectations of the patentee, and many of his scientific friends, it will be of essential service *in lessening some of* the expenses and difficulties incident to *the formation of railroads.—Builder*, No. 152.

IRON SKEW BRIDGE.

A VERY bold and ingenious specimen of a Skew Bridge has been erected on the line of the North British Railway, at the south foot of the Calton-hill, Edinburgh. It consists of six strong beams of cast iron, each composed of four or five pieces joined with rivets, and cast in the form of an arch. They are about 80 feet long; the roadway from wall to wall is 26 feet broad, and has a narrow foot-path on each side, at the outer edge of which cast-iron columns are placed, supporting the beams at 10 or 12 feet from either extremity. The beams rest on their ends on solid masonry, and are fastened to each other by strong wrought-iron bars running across them at right angles. The angle of the skew—assuming the clear space, from wall to wall, along the beam to be 74, which we believe is very near the truth, and the actual breadth of the road and foot-path being 26 feet—it follows that the obliquity, or the angle of the skew, is 20 degrees.

STEPHENSON'S IRON TUBULAR RAILWAY BRIDGE.

ONE of the most extraordinary projects for railway communication is now in course of construction, for carrying the Chester and Holyhead line across the Menai Straits.

It appears that the Government having refused to sanction the use of the Menai suspension bridge of Telford for the above purpose, on account of its proved insecurity, a new bridge of two arches, at a different point of the Strait, was therefore determined on; where, however, one of the arches must inevitably have a span of not less than 450 feet. For this object, the engineer originally proposed a cast-iron arch, of a circular segment, in nearly the usual form; but it was decidedly objected to by the Admiralty, as not affording sufficient head-way, near the spring of the arch, for ships under full sail. A bridge perfectly flat from one side of the arch to the other was thus rendered imperative, and the engineer had, accordingly, to accomplish one of the most difficult problems yet unsolved in railway history. Mr. R. Stephenson has already carried out the use of iron in railway-bridges to a greater extent than most other engineers; and for this purpose he is to adopt the favourite material, and *is about to lay across the Menai Straits* AN IRON BEAM 462 *feet long*, supported on stone pillars at both ends. The proposal is bold; but the method proposed for executing it is ingenious. This great iron beam, 462 feet long, is to be 30 feet deep, and 15 feet wide, with a hollow in the centre; and this hollow is to be so large that the railway train shall pass along in the heart or centre of the beam. This beam will simply be laid across the Menai Straits; one end joining the railway on one side of the straits, and the other end joining the railway at the other side of the straits; so that passengers going along the line will simply be whirled through the heart of the beam without any perceptible *difference between* this and any other part of the line, which may *happen to be covered* in or arched over. It is, in short, to be an iron *tunnel hung up* in the air across an arm of the sea!

For the purpose of ascertaining the best form of bridge, a series of

experiments has been undertaken by Mr. Fairbairn, aided by Mr. Hodgkinson, which has led to valuable and important results. They have put us in possession of facts which will greatly increase our knowledge of the properties of a material whose powers of combination were but imperfectly understood; for, exclusive of the rapidly increasing use of wrought iron in the construction of ships, boilers, and other vessels, its application to bridges of the tubular form is perfectly novel, and originated with Mr. Robert Stephenson.

The experiments of the most conclusive character were those made upon a model tube of a large scale, containing nearly all the elements of the proposed bridge, and the various conditions with regard to form and construction which had been developed by the previous inquiries. At first, it occurred to Mr. Fairbairn that the strongest form would be that wherein the top and bottom consisted of a series of pipes, with rivetted plates on their upper and lower sides. This form of top would possess great rigidity, and is well adapted to resist the crushing forces to which it is subjected; and, on the other hand, the bottom section appeared equally powerful to resist tension. Mr. Fairbairn is inclined to think that this is the strongest form that can be devised; but practical difficulties present themselves in its construction, and in an easy access to the different parts for the purposes of painting, repairs, &c.

The conclusive nature of the whole of the experiments on the model tube is highly satisfactory: they exhibit extraordinary powers of resistance; and, considering that the weight of the whole material contained in the tube does not exceed 5 tons; that the distance between the supports is 75 feet; and the load in the middle 11 times its own weight, or 22 times if equally distributed: it is probably not over-rating its powers to state that hollow beams of wrought iron, constructed on this principle, will be found, (whether used for bridges or for buildings,) about three times stronger than any other description of girders.

Subsequently, Mr. Hodgkinson undertook another series of experiments for the above purpose. The result has been, that the proposed tubular bridge has undergone certain alterations, according to Mr. Hodgkinson's recommendations:—1st, In the thickness of the side, to enable it better to resist the action of the wind. 2d, In the top being made straight, instead of curved, to allow the escape of the steam. 3d, In reducing the rectangular cells at the top. In this last instance, however, since rectangular tubes are weaker than square ones to resist compression, and these much weaker than cylindrical tubes, Mr. Hodgkinson hopes the latter will be substituted for the former; as it would, according to the preceding experiments, effect a saving of one-fourth of the metal in the top, leaving the strength the same. This matter is of the more consequence, as the weight of the tubular bridge will bear so large a proportion to the breaking weight.

The entire result is thus summed up by Mr. Shepherd, the engineer:—*Hence, therefore, we have* arrived at a most interesting result; viz. *that the liability of* the plates on the upper side to crush has been

completely removed from the construction in compartments. The experiments having now furnished us with the necessary means of calculating the relative thickness and proportions of the several parts of the tube, we are in a condition to contract at once for their construction." Accordingly, on the 14th of October last, the Railway Company contracted for the construction of the first portion of this bridge, which is to be called "The Britannia." It is 462 feet span. The greatest span of any *rigid* bridge hitherto executed is 240 feet. To avoid the effect of vibration, it is intended to lay the rails on vulcanised India-rubber, about two inches thick. The tube will be elevated to its position in compartments, to be afterwards rivetted together when fitted. The first compartment nearest the pier will be raised on pontoons at high tide, and fitted into a rest at the bottom of a groove in the pier, up which it will be elevated by hydraulic pressure.

The Report of the above experiments was, perhaps, the most striking communication made to the Mechanical Section of the British Association, at their late meeting. The details of the experiments will be found reported in the *Athenæum*, No. 989; and the subject was thus felicitously referred to by the President, (Sir R. I. Murchison), in his inaugural address:—

"Among the many useful national objects which have been promoted by the British Association, there is one which calls for marked notice at this time, in the proposal of Mr. Robert Stephenson to carry an iron tube, or tunnel, over the Menai Straits, to sustain the great railway to Holyhead. This bold proposal could never have been realized if that eminent engineer had not been acquainted with the great progress recently made in the knowledge of the strength of materials, and especially of iron; such knowledge being in great measure due to investigations in which the Association has taken, and is still taking, a conspicuous share, by the devotion of its funds, the employment of its influence—investigations which have been prosecuted with great zeal by its valued members, Mr. Hodgkinson and Mr. Fairbairn."

It is proposed to construct a similar bridge at Conway.

STRENGTH OF MATERIALS.

An interesting and important experiment has been made at the Prior Field Iron Works, Birmingham, on some cast-iron girders intended for the steam factory buildings at Portsmouth. Nothing could be more satisfactory than the result, as the girders did not break till they had sustained the weight of 30½ tons over the weight which the strength of the girders, computed from Hodgkinson's rules, was calculated to break with. The mass of iron distributed over these girders exceeded seven feet in height, and showed that the castings were capable of sustaining a very much larger weight than they could ever be loaded with in the factory for which they are intended.—*Aris's Birmingham Gazette.*

TAYLER AND CONDER'S PATENT ELECTRO-MAGNETIC RAILWAY.

The present invention is stated to consist in "the application of *Electro-magnetic* power to what is commonly known by the name of the atmospheric system of railway propulsion, in order to

connect the piston carriage of a train with the driving piston within the tube." In the top of this tube is a longitudinal slit or opening, as usual, but much narrower; and a continuous air-tight cover is bolted down upon the longitudinal slit. The tube is of iron, but the cover is made of copper, brass, or some other substance not susceptible of the electro-magnetic influence, and bolted to the tube by copper bolts. The driving piston consists of two end discs, of the same diameter as the interior of the tube, (or nearly so,) connected by a rod; this carries upright square pieces, called armatures, which project upwards through the top slit in the tube, and fit into the square space within the cover. These armatures are made on the under part of some substance not susceptible of the electro-magnetic influence, as brass, or wood, but capped at the top by pieces of iron secured by copper bolts. To the bottom of the piston carriage are attached (instead of the usual piston connecting rod) electro-magnets, each of which presents its two extremities or poles to the sides of the cover. The power of these magnets may be increased by enclosing them in a tube or case of iron, leaving the extremities or poles open. A galvanic battery is placed in the piston carriage, and which may be of any approved form and of any required power; and there are wires by which the battery is connected with the electro-magnets. The mode of action is as follows:—Motion being given to the piston by exhaustion (more or less) from the tube of the air in front of the piston, and the magnets being at the same time connected with and excited by the battery, the magnets act by induction on the iron armatures attached to the piston rod, as they come within the sphere of their attraction (the cover offering no obstruction to that attraction, as it is of a substance not susceptible of electro-magnetic influence), whereby the magnets and the armatures become virtually coupled together, and draw along with them whatever carriages may be attached to the carriage which holds the magnets and battery.—*Abridged from the Mechanics' Magazine*, No. 196.

ATMOSPHERIC RAILWAYS.*

The hitherto defective mode of working the Atmospheric Railway has originated some ingenious inventions, during the past year; among which are the following:—

Wheeler's Patent System bids fair to realize the seeming desideratum, viz. an Atmospheric Railway, working by means of a piston traversing a close tube, devoid of any valve or opening, through which leakage, and, consequently, loss of power, can accrue. No atmospheric air can enter the main pipe, except at its further extremity, behind the piston. If it be desirable to admit the atmospheric air

* Extraordinary speed has been attained on the Croydon atmospheric line. A Correspondent of the *Morning Herald* states: With a train of four carriages, including the piston carriage, which carries passengers, and weighing about 22 or 23 tons, *we reached a velocity of seventy-five miles* per hour. This speed *was maintained over a distance* of a quarter of a mile. Over a similar distance, *in the same trip, we got* a velocity of 69·23 miles per hour; over half a mile, *a velocity of* 64·28 miles per hour; and, for a mile and a quarter, exactly *60 miles per hour.*

through the piston, in aid of the breaks in stopping the carriage, or otherwise, it can be effected by the guard on the carriage drawing back the lever, which depresses a small wheel; this wheel, pressing down the diaphragm, depresses an internal wheel; this, by means of a lever, raises and opens a valve, in the end of a pipe, which passes through the piston. When this valve is opened, the atmospheric air will pass through the piston into that portion of the main pipe which is in advance thereof. At other times, the valve is kept closed, and the proper position of the wheel and lever maintained by a balance weight. For an explanatory extract from the Patentee's specification, see *Mechanics' Magazine*, No. 1206.

M. Pecquier's System is a plan for working an atmospheric tube by compressed, instead of rarefied, air; and, except in some of its modifications, is on the principle of any of the known systems, as regards tubes, pistons, &c. By employing compressed air, the inventor considers many advantages will be obtained; such, for instance, as in ascending or descending inclines, the power can be regulated to any required pressure; much greater economy is secured than by rarefaction, and there are less chances of accident.

Clarke and Varley's Patent Resilient System proposes to obviate the difficulties attendant on the preservation of a perfect vacuum by the peculiar construction of the tube, which in other systems is made of cast iron. Its peculiarities are thus described:—In this plan, the tube is of sheet iron, wrought into the circular form, and so constructed as to form a very powerful spring. The two edges are not joined permanently together, but provided with tips about 1½ inch in height; and to one of these a piece of leather, India-rubber, or some other elastic substance is attached, so that when the two lips are pressed together, as they naturally are when not kept apart by the connecting rod, a joint is formed which is perfectly air-tight, without any composition whatever being used to effect that purpose. At intervals along the tube are powerful springs, intended to exert a great pressure upon its lips. The connexion between the piston in the tube and the first carriage in the train is by means of a connecting rod similar to those in other systems. The quantity of iron required for the tube will be, the inventors contend, most materially diminished, the thickness required for a tube of 18 inches diameter being only an eighth of an inch, while the thickness necessary for a tube on Samuda's principle would be 1½ inch.—*Railway Chronicle*, No. 30.

Swinburne's Patent System substitutes for the long traction tube a number of short and entire tubes, placed at considerable distances apart; and is thus able, with 5 or 10 miles of tubing, to work 50 or 100 miles of railway. The transit is to be effected by a continuous succession of separate and distinct forces; one force taking up the task of transmission as the other (from exhaustion) lays it down. *Each of* Mr. Swinburne's short tubes is, in fact, a veritable air *mortar, which projects* a piston from it with such force, as to carry *the piston and any train of* passengers or goods attached to it forward *to the next mortar of* the series.

The tubes may be used for propulsion in opposite directions, so that there will be no occasion for double lines; and the difficulties now experienced in the crossing of atmospheric lines will be entirely obviated by this plan.—See the details in the *Mechanics' Magazine*, No. 1203.

Collier's Patent System also dispenses with the longitudinal valve altogether; or, at least, destroys its unity, and cuts it up, as it were, into a multitude of small valves, ingeniously protected by air-tight apparatus,—through which, nevertheless, the power of the interior appears to be effectually conveyed to the exterior purpose, so as to accomplish all the ends of the ordinary atmospheric machinery, without its disadvantages; at least, if not without equivalent disadvantages of another sort. Among the minor difficulties surmounted, are the following:—Air is prevented from entering the antecedent vacuum of the traction-pipe through the boxes covering the slits, while the piston is passing beneath them, by the requisite operation of a double piston and a spring. The driving rod is supported, independently of the gearing of its notches, by another piece of mechanism; and, besides other appropriate and necessary devices, there is a modification of the whole invention, which consists in the formation of, or recurrence to, a continuous slit or longitudinal groove in the traction pipe, but covered by a series of continuous air-tight boxes, running each a length of 25 feet or so, first on or towards one side of the slit or pipe, and then for an equal length towards or on the other; the rod threading its way through them, and entering and exiting through valved apertures, to the same effect as before, in connection with similar forks, but without springs, or in connection with "griping instruments or pincers" instead of forks at all.

COMPRESSED AIR RAILWAY.*

THIS invention has been patented by Maj. Nickels, and a working model of the same exhibited at the Adelaide Gallery.

"The medium of the motive power is an apparatus of iron, having grooves along the sides, which are formed with extreme accuracy. A section of this apparatus will shew a curve on either side, which curves are segments of a circle of like diameter. Along the sides of the grooved iron beam, pieces of cloth, prepared with 'gutta percha,' are laid, and bolted securely down at the top and bottom edges. This cloth is not tightly strained across the grooves, but is partially loose, so that it may be adapted to the curve or hollow; and so that the condensed air may be blown in between the cloth and the iron groove, to inflate the cloth, and cause it forcibly to project at the sides of the beam; thus converted, as it were, into a flexible or elastic tube. Fixed to the carriage, and descending so as to work with exactness on either side of the beam, are two thick wooden wheels, or friction rollers, the peripheries of which are turned exactly to correspond with curves in

* *In the Year-book of Facts*, 1846, will be found Notices of other applications of the Power of Condensed Air, by Messrs. Pratt, Parsey, Reimagle, *Nasmyth, and James*. (See pp. 5—7.)

the sides of the iron beam. These rollers are tightened, laterally, by means of a cross bar and nuts, until they bind tightly against the cloths with grooves. When the condensed air is admitted behind the carriage, it rushes towards these wheels, and inflates the tubes in its progress; and presses forcibly against the wooden wheels, which, binding tightly upon the curves, present a barrier to the passage of the air until its pressure overcomes its resistance; the wheels, with their carriage, yield to the power, and, with the train, are propelled along the line. It is not intended, in practice, that the whole column of condensed air shall be set in motion; but that the centre beam shall be hollow, and serve as a receptacle or store for condensation, so that the air shall be let out in puffs, as it were (within the cloths), at intervals, in the length of tubing, by means of a system of valves, which may or may not be opened, at the will of the engineer, during the passing of the train."

This is effected by an arrangement in the form of a skate, pressing on elastic upright valves at intervals in the beam, but which may be screwed up at will, to run clear of them. The carriage, with two persons on it, was propelled with great speed the whole length of the Gallery; the length of the tube for the inflating moving power being only about twelve feet.

NASMYTH'S STEAM HAMMER.

This invention was noticed in the *Year-book of Facts*, 1845, p. 44; where two stupendous specimens are described. Mr. Nasmyth has since constructed a Steam Hammer at Sir John Guest's iron-works at Dowlais. The hammer, or block of cast-iron, which gives the blow to the iron on the anvil, is upwards of six tons weight, with a clear fall of seven feet perpendicular. The force of the blow which this gives out is tremendous; but is under such control as to be made to drive a nail into soft wood with a succession of the most delicate taps. This monster hammer has been constructed for giving some six or eight tremendous blows to each of the piles or blooms, from which railway bars are rolled, so as to thoroughly weld them into one solid mass ere they go to the rolls, to be extended into the finished rail. These rail blooms are 3 ft. 9 in. to 4 feet long, and about 10 in. square; and as the hammer face is 3 ft. 9 in. long, by 2 ft. wide, it covers every part of the surface of the bloom at each blow. It is a remarkable sight to see the effect of these massive blows in expressing every article of cinder from the bloom; in the most important degree enhancing the quality and durability of the rail so produced. The anvil of this monster steam hammer is supposed to be the largest casting in the world—being no less than 36 tons in one solid mass. This important invention is now making rapid progress in regard to its adoption by iron manufacturers all over Europe and America.—*Mining Journal.*

THE PLUMB-LINE IN THE ISLE OF WIGHT.

A paper has been read to the British Association, "On Certain Deviations of the Plumb-line from its Mean Direction, as observed in the neighbourhood of Shanklin Down, in the Isle of Wight, during

the progress of the Ordnance Survey," by Mr. W. Hopkins. The difference of latitude between Greenwich and the station of the Ordance surveyors at Dunnose, on the north side of Shanklin Down, as determined by triangulation, was greater by 2·22 seconds than as determined by zenith sector observations. When, however, a new station was chosen on the south side of Shanklin Down, the difference of latitude, as determined by triangulation, was less by 3·09 seconds than it appeared to be when determined by the zenith sector. These discrepancies would be accounted for, if the mass intervening between the stations at Shanklin Down were sufficient to produce, by its attraction on the plumb-line, the observed deviations. The requisite calculations for proving the adequacy of this cause had not been made; the tendency, however, would necessarily be to produce effects of the same nature as those observed; and the author thought it probable that the intensity of the attraction of the hill would be found sufficient to account for the phenomena.

ON COMPENSATION PENDULUMS. BY W. H. MEIKLE.

At the Manchester meeting of the British Association, the late lamented Professor Bessel brought forward some speculations regarding Pendulums, and called attention to certain circumstances which he thought had till then been overlooked. As, for instance, the defects of various compensations arising from the different parts of a pendulum not being all at the same temperature; and, in particular, the imperfections of the mercurial pendulum on this account. But, whoever will take the trouble of looking into the article *Pendulum* of the Encyclopædia Britannica, will find that such ideas are by no means so new; because I had there pointed out the same things, and they were published more than four years before the illustrious astronomer of Königsberg took up the subject.

There is, however, I suspect, another defect in the mercurial pendulum; and which, so far as I am aware, has not yet been attended to. The performance of that pendulum is always assumed to be exactly the same as if the mercury in it were a perfectly rigid mass. But, since mercury is allowed to be one of the most perfect of fluids, there can be no doubt, that, when the pendulum is in motion, the surface of the mercury, which is of considerable extent, must be in a state of perpetual undulation. The precise amount and effect of this, it will be no easy matter to determine; but there is reason to think that it must tend to retard the pendulum, and to add to the inequality of the times of the greater and less vibrations. One way of nearly obviating it would be to use a less mass of mercury, and put it in a bottle with a narrow neck, the upper surface of the mercury being half way up the neck. But this would not necessarily do anything towards giving the same temperature to the whole pendulum rod, or the mean temperature to the compensation, unless the centre of gravity of the mass of mercury were near the middle of the rod. In that form, however, the mercury could not conveniently serve as the principal mass of the pendulum.—*Jameson's Journal*, No. 82.

INSTANTANEOUS LIGHT.

Mr. Schloss, of Finsbury Square, has patented "an Improved Instrument or Instruments, for producing Ignition;" to provide travellers, miners, woodmen, and smokers, with a portable apparatus for the purpose of producing the combustion of any material, easily ignited by friction.

It consists of a small box, fitted with a sliding cover, and unequally divided by a partition, extending about two-thirds its length, the smaller compartment forming a chase into which is fitted a spiral spring capable of being compressed into about one-fourth its length, and held in that position by a catch acted on by a thumb bolt, passing through the outer case; the other end of the chase is furnished with a bolt or slide, passing through the case: the larger compartment is used as a store for the matches. On the end of this is fixed a spring, placed across the box, the end of which is curved and nearly opposite to the end of the chase, before mentioned.

The material preferred for the matches is amadou (otherwise German tinder), prepared from the plant *boletus ignarius*, steeped in a strong solution of saltpetre, cut into thin slips to suit the size of the chase.

To prepare the box for use, the spiral spring is to be compressed, which will be held in that position by the catch; the chase being filled with matches, the spring must be released by the thumb bolt, which will force them against the slide.

The action of this apparatus is as follows:—The slide being drawn out as far as the stop will allow, the match, which corresponds in size and thickness next it, by reason of the pressure from the spiral spring, will immediately take its place on the slide; being smartly driven back, it will be forced between the spring that is placed across the box and the end of the chase, the pressure of the spring being sufficient to create the friction necessary to procure ignition: the match thus forced will pass into the undivided portion of the box, when the sliding cover must be partially removed for the admission of air necessary to sustain combustion. The operation may be repeated as before, until the matches are all displaced from the chase.—*Patent Journal*, No. 5.

FORCE OF THE WAVES IN MOVING MASSES OF ROCK.

In the Frith of Forth, at the Granton Pier Works, Dec. 19, 1846, after a gale from the north-east, one stone was moved measuring fifteen cubic feet, or about one ton in weight, and thrown on the beach, after having been built into the wall; and a stone containing 18 cubic feet was moved 30 feet from its place; while the *pierres perdues* or mound-stones were washed down to a slope of about 4 to 1.

The following instance, which occurred at the landing slip of the Calf Point, Isle of Man, affords a proof of the great force of the waves even in the Irish Sea. During a gale from the north-west, a

block was lifted from its place in the wall and thrown landwards, which measured 123½ cubic feet, equal to about 10 tons weight.

In the German Ocean, we can refer to the Bell Rock Lighthouse, which, though 112 feet in height, is literally buried in foam and spray to the very top, during ground swells, when there is no wind. It is, therefore, a very important station for making such experiments, because the rise of the spray may be regarded as a scale by which the results of the Marine Dynamometer can be checked or compared.

In the published account of this work there occurs the following statement:—On the 24th October, 1819, the spray rose to the height of about 105 feet above the rock. "It may, perhaps, therefore," says the author, "be concluded, that the maximum force of the sea at the Bell Rock is to raise the sprays to the height of about 105 feet above the surface of the rock;" and deducting 16 feet, which is the height that the tide rises upon the tower, there is left 89 feet, as the height to which the water is raised. This is equivalent to a hydrostatic pressure of about 2½ tons on the square foot. Since that time, however, there have been still greater proofs of the force of elevation. On the 20th November, 1827, the spray rose 117 feet above the foundations or low water mark; and the tide on that day rose 11 feet above the tower, leaving 106 feet as the height of elevation (exclusive of the trough of the sea) being *equivalent to a pressure of very nearly 3 tons per square foot.*

At the island called Barrahead, one of the Hebrides, a remarkable example occurred during a storm in January 1836, in the movement of a block of stone, which, from measurements taken on the spot, is 9 feet × 8 feet × 7 feet = 504 cubic feet; which, allowing 12 feet of this gneiss rock to the ton, will be about 42 tons weight. This great mass was gradually moved 5 feet from the place where it lay, having been rocked to and fro by the waves till a piece broke off; this, rolling down, and jamming itself between the moving mass and the shelving rock on which it rested, immediately stopped the oscillatory motion, and thus prevented the further advance of the stone.

Mr. Reid, the principal keeper of Barrahead Lighthouse, the assistant keeper, and all the inhabitants of the little island, were *eye-witnesses* of this curious exhibition of the force of the waves; and Mr. Reid also gives the following description of the manner in which they acted upon the stone.—

"The sea," he says, "when I saw it striking the stone, would wholly immerse or bury it out of sight; and the run extended up to the grass line above it, making a *perpendicular* rise of from 39 to 40 feet above the high water level. On the incoming waves striking the stone, we could see this monstrous mass of upwards of forty tons weight lean landwards; and the back run would uplift it again with a jerk, leaving it with very little water about it, when the next incoming wave made it recline again. We did not credit the former inhabitants of the *island, who remarked that* the sea would reach the storehouse we *were building; and when* these stones were said to have moved it was *treated with no credit,* and was declared by all the workmen at the

lighthouse-works to be impossible; yet the natives affirmed it to be so, and said if we were long here we might yet see it. They seemed to feel a kind of triumph when they called me to see it on the day of this great storm."—*Thomas Stevenson, Civil Engineer, in Edinburgh Royal Society's Transactions*, Vol. xvi., Part 1.

COPPER AND IRON OF RUSSIA.

The chief seat of these metallic riches of Russia is the eastern flank of protrusions of igneous rocks along the eastern flank of the Urals. Sir R. I. Murchison adduces several curious facts to show that some of the ores of Copper, particularly the green carbonate or malachite, are aqueous productions, derived from pre-existing ores, as calcareous stalagmites are derived from limestone rocks. In the copper mine of Nijny Tagilsk, at a depth of 280 feet from the surface, an immense irregularly-shaped botryoidal mass of solid pure malachite was found, of a bulk estimated at upwards of half a million of pounds weight, presenting in its interior the wavy radiations and silky structure of that beautiful mineral; almost identical in structure with many calcareous semi-crystalline minerals, of whose aqueous origin no doubt exists.

All the best iron of Russia is brought from the Ural chain and its flanks. It is found in veins in greenstones, and intermixed with the mass of erupted rocks of that class, often in great abundance at the junction of the igneous and stratified rocks, these last being in a metamorphic state. Magnetic iron ore is the chief form in which the metal is found; and it constitutes vast masses, sometimes worked in an open quarry.

THE MUSCHET BAND.

This Black-band Ironstone of the Coal-field of Scotland was discovered, about forty years ago, by Mr. David Muschet, of the Calder Iron-works, near Glasgow. It had been frequently passed through; but was thrown away as rubbish till Mr. Muschet ascertained its value,—when extensive mines were opened for working it. Two bands of this ironstone are found in the great coalfields of Lanark,—one 14 inches thick; the other, which is 73 fathoms lower, is 16 inches thick. The ironstone of the Muschet band is much more easily reducible than the ordinary dry ironstone, and requires less fuel. In Scotland, it appears to be co-extensive with the coal formation. In South Wales, also, it is found; but there is little of it in England or Ireland. Fifty years ago there were only five iron-works in Scotland, comprising about fifteen blast furnaces, which, together, produced 540 tons of iron per week. There are now 100 blast furnaces in action, which produce 12,000 tons per week, or 624,000 tons *in the year*,—the value of which, at £3 per ton, is £1,872,000. *This great increase* is attributed to the discovery of the Muschet ironblast.—*Mr. Bald, to the British Association.*

ANHYDROUS STEAM.

A PATENT has been taken out lately for improvements in steam-engines, the principle of which, we understand, is founded on the use of Anhydrous or Dry Steam. The inventor, Dr. Haycraft, has been favourably known to the scientific world by his researches into the capacities of the different gases for caloric, published by the Royal Society of Edinburgh in their *Transactions;* and referred to in the first volume of the *Transactions of the British Association*, chiefly in relation to the atomic theory.

It is some years since, if we mistake not, that Dr. Haycraft developed his theory on the use of anhydrous steam: it is founded on the fact, that, if water be deposited in the interior of a cylinder of a steam-engine, it subsequently is evaporated every time the eduction valve is opened; and, by its evaporation, tends constantly to cool down the cylinder in a ratio proportionate to the evaporation, and, consequently, to the quantity of water deposited in the cylinder. The theory itself is novel, and derives strong support from the facts of the case. It has been long known to practical men, that, if a boiler, in consequence of deficient steam room, or from other causes, prime considerably, a much increased consumption of fuel is required, while, at the same time, the power in the engine is diminished. To this cause may be attributed the enormous diminution of the power of locomotive engines in proportion to the fuel employed, as compared with other engines where a sufficiency of steam room is attainable.

Mr. Penn, of Greenwich, has applied the invention to a small flour-mill, with the result, as we are informed, of a consumption of only 4 lbs. per horse-power per hour, and this though the engine is low pressure, and the boiler a temporary one, with deficient steam room, and exposed to the weather.

The peculiar care taken in the Cornish engines to render the steam perfectly anhydrous, doubtless, contributes, together with their great size, to render their proportional consumption of fuel so small. Their construction unfortunately renders them inapplicable for general purposes; but we see no reason why the same principle of using anhydrous steam should not be applied to engines of the ordinary construction.

We are informed that neither high pressure nor dry heat, as it is called, is used by the patentee to produce his results.—*Mechanics' Magazine*, No. 1183.

THE EMERALD SCREW STEAMER.

IN the trials with this Vessel, some important points have been decided. She was built by Mr. Cato, with engines by Messrs. Fawcett, Preston, and Co., of Liverpool, for the City of Dublin Company. She was modelled by Mr. Grantham, is 700 tons measurement, and 50 horse-power. The *Emerald* was first tried with 70 tons of dead weight on board, and afterwards with 120 tons. Her speed, *under steam alone, in* smooth water, averaged $7\frac{1}{4}$ nautical *miles per hour; and was never* less, when going head to wind, with a *considerable swell, than* 5 *knots*. During the trials, few opportunities

occurred of using her canvas, but enough was seen to show that her speed will be very great with sails. The greatest feat, however, for the success of the principle, was exhibited in the towing of the *Brenda*, bark, from the Bell Buoy to the Rock, at the rate of 5 and 5½ knots per hour, through the water. The Brenda is a full-built ship, barque-rigged, is 28 feet beam and area, 14 feet water. The question as to the success of the screw as a propeller, perhaps, would not now be doubted, but the difficulty of working it has been considered a great obstacle to its adoption. This experiment, however, proves that the high velocity at which it has usually been worked, is unnecessary; and that the ordinary condensing engine may be connected direct to the screw-shaft, without requiring the piston to move at any unusual velocity. The speed of the piston, when the vessel was going 9 knots, was considerably less than that of the common paddle-wheel engine.—*Liverpool Standard.*

THE "TERRIBLE" WAR STEAMER.

THIS magnificent Government vessel has been fitted at Woolwich: she has 20 guns mounted. On her upper deck, each side the bow, are two long 56-pounders, Monk's 11-feet guns, to fire fore and aft in a line with the keel; these are mounted on a slide, and will cross fire with each other, and also sweep round to the sides; two more of the same guns, right aft in the stern, will also cross and sweep to the broadside on their pivot, so as to fire forward, acting as chase guns if required. She has two 68-pounders on each broadside, to carry shells or solid shot, which can be trained fore or abaft, according to circumstances. On the deck below, which is also flush fore and aft, are eight guns, viz. two long 56-pounders, Monk's guns, 11 feet long, in the bow ports, to fire in a line with the keel; and also several degrees of training on the broadsides, and two of the same guns in the stern, right aft, which can give such depression as to prevent even a small boat from coming under her stern; with four guns, 68-pounders, on her broadsides, for shells or solid shot. There are four smaller guns on the upper deck, to be traversed to any place, or carried on shore in her paddle-box boats, if required for use in landing troops, &c. She has four separate boilers, independent of each other, which may be connected when required; four funnels, one to each boiler; the two after ones strike down, so as to allow a square mainsail to be set when sailing, and still using the two foremost boilers, thus working half her power, at the same time saving a considerable consumption of coals. As there are four small funnels instead of one large one, this is a great advantage, as the ship will not be wholly disabled by losing one, two, or even three funnels.

The *Terrible* has two magazines, and two shell-rooms, one of each before the engine-room, and one abaft, for the safety of the vessel, to prevent any powder passing the engine-rooms when firing the guns. She can store 400 tons of coals below the lower deck, and is prepared on the midship part of the deck to take 200 or 300 tons more, packed in bags, as a defence from shot to the engine and boilers, filling up a

space of 18 feet. In addition to her thick, substantial, solid sides, she has good capacity, and, if required for any particular service, can carry more coal in sacks. With regard to the conveyance of troops, she can berth 1,000 men under cover on her second gun-deck, independent of her ship's company, their berth being below forward, and the officers' cabins, gun-room, &c. abaft; so that each gun-deck is entirely clear, and always ready for action, without removing a bulkhead, and the deck being perfectly free from the captain's cabin abaft to the bow of the vessel. She is constructed in the strongest and most substantial manner, on Mr. Lang's improved method of uniting the frame timbers, making her perfectly water-tight, so that she would swim even if her external keel and plank were off her bottom. This method is also adopted in the *Royal Albert*, 120 guns, now in her frame, and may be seen in the slip in Woolwich Dockyard. The engine-room of the *Terrible* is most splendid: on deck, the whole length of the engine-room, are gratings, open and well ventilated by hatchways, giving light and air to the engineers, stokers, &c. It is an admirable plan, such as no steamer as yet has the advantage of; and each boiler has a separate hatchway, through which it may be readily taken out for repair, without interfering with the other boilers. The *Terrible's* engines are most majestic: they are 800-horses' power, the production of Messrs. Maudslay, Sons, and Field, and show to advantage in this large war steamer. Her decks have hatchways in various parts, scuttles, skylights, &c., for ventilating the ship even to the lower parts of her hull; and there are many other conveniences, too numerous to mention, contributing to the efficiency of the ship, and the comforts of the officers and crew, so that she may be said to be the largest and most perfect war steamer ever built.—*Nautical Standard.*

COMMODORE SIR CHARLES NAPIER'S STEAM-SHIP, "SIDON."

THIS noble steam-ship has been built in the Government dockyard, at Deptford, from a design by Commodore Sir Charles Napier, who maintains that his model possesses certain advantages of construction, which he has long maintained in his place in Parliament, should be secured in the designs for Government-built steam-ships.

Among these advantages, are certain facilities and ample room on the upper and lower decks for firing her guns; excellent accommodation for the officers and crew, and a very large space for her engines and boilders, the latter being so placed that they are three feet under her water-mark; all the vulnerable parts of the engines are of gun-metal; and, in the event of a shot going into the boilers, there is an escape for the men. The powder magazines are, also, remarkably secure; and very easy access can be add to them.

The figure of the *Sidon* appears to be one of great stability; and at a short distance above her water-mark she is thrown out considerably on her sides, which give a large additional breadth to her decks. She has ample room for stores sufficient for lengthened voyages. She was commenced on June 24, 1845, and launched on the 26th of May last.

so that she was eleven months in construction. The following are her main dimensions:—

	Feet	Inches.
Length between perpendiculars	210	9
Ditto of keel, for tonnage	186	0
Breadth extreme	37	0
Ditto for tonnage	36	6
Ditto moulded .... ;............	35	10
Depth in hold..............................	27	0

Burden in tons, 1,328 67-94. Horse-power, 560.

The *Sidon* drew, when launched, 9 feet; and, with everything on board, will be under 14 feet; she takes in coals until her main deck ports are within 6 feet of the water, which will be between 700 and 800 tons. She has two 56-pounders pointing right ahead; and two right astern. On the upper deck are four 32-pounders on the broad-side, which can be pointed two on each bow and quarter. She has ten 32-pounders on the main deck; two pointing right ahead, and three right astern; or two right astern, and two on the quarter, out of the Captain's cabin, running clear outside the ports. She is upwards of 500 tons less than the *Terrible*; and 300 tons less than the *Retribution*: the latter vessel having no guns at all on the main deck. Her engines are by Seaward and Co.

An accurate engraving of this steam-ship, with sectional details, has been given in *The Illustrated London News*, No. 221.

THE RAILWAY REGULATOR.

This is one of the most ingenious and useful applications of mechanical contrivance for the accomplishment of the object indicated by its title. It consists of a dial about five feet in diameter, upon the upper half of which is a series of numbers, showing the distances of each station along the line of railway, the number of hours occupied by every train in both directions between each station, and the several stations and stopping-places between the extreme termini. In the centre is a clock dial, by which the departure and arrival of every description of train can be ascertained at a glance. The several trains are indicated by elongated hands, which are worked by a movement constructed according to the speed required, and attached to the works of the clock. In the Railway Regulator, the goods train travels at the rate of 12½ miles an hour, the passenger train at 25 miles, and the express train at 50 miles an hour. The construction of this useful apparatus is simple, and cannot get out of order. It can be adapted to suit any required speeds, and by shifting the hands the hours of departure can be varied as circumstances may demand. Its accuracy is perfect, and, without reference or limitation to the number of departures, it shows at once the position of every train upon the entire length of line; and when any material alterations are made in the hours of starting, it prevents all possible confusion and risk of accidents from this cause, by showing the places at which arrangements require to be made for express and quick trains passing slow ones.—*Times*.

FAIRER'S RAILWAY CLOCK.

Mr. Fairer, of Tottenham, has, at the suggestion of Mr. J. Pilbrow, C. E., designed an "improvement in Clocks and Timepieces intended to be used on Railways, at their stations, and in towns and taverns on their route, being more especially adapted for such trains as run east or west." The want of such an improvement has long been felt; for, as a line running from London east or west, keeping its own time throughout, in order to agree with London time, would differ from the *local* time very considerably at its extreme end, and more or less so at every intermediate station, it is, consequently, the source of numerous errors, inconveniences, and disappointments.

The clock, timepiece, or watch, is of the usual construction; but, instead of the common minute or long hand, there is placed the segment of a circle, corresponding in width to the greatest difference of time upon the line of railway in minutes. This segment is proposed to be of thin glass, consequently, showing the hour hand when it passes over it. Upon this segment is written, in plain and conspicuous style, the names of the places, such as the two extreme termini, and the place the clock is located, or, instead, the word *local.* For instance, *London*—Local—Exeter; thus, varying these, and placing them as the distances from the proper time of each place, persons will always see, at a glance, the time for the locality, the time of railway, and time of extreme terminus.

Mr. Wheatley, of Brompton, who thus describes the improvement in the *Mechanics' Magazine*, suggests, as a still further improvement, that the words or names of the places, such as London, Exeter, Local, should be so arranged on the segmental minute hand, that they would move upon a centre, or, being weighted, would keep their horizontal position, whatever situation the hand itself may be in; thus rendering it easier for reading at all times.

A Correspondent of *The Builder*, also, suggests: an outer circle of minutes, beyond those usually laid down on the face of the clock; and this outer circle is so divided, that the minute-hand shews upon it the London time at the same instant that it shews Local time on the usual minute circle.*

CANAL ACROSS THE ISTHMUS OF PANAMA.

The subject of improved communications between the two sides of the American Continent, always interesting, is becoming more so every year.

We are indebted to Persifor Frazer, Esq. for sending us from Paris a copy of the Report of Napoleon Garella, an engineer appointed by the French government, under the auspices of M. Guizot, to make a scientific survey of the Isthmus of Panama, in reference to the construction of a Ship Canal between the Atlantic and Pacific oceans. The survey was made in 1844.

This report, *unlike other publications* on the subject, bears evidence

* *See M. Vulliamy on Railway Clocks,* "Year-Book of Facts," 1846, p. 22.

of professional ability, careful study, and impartiality in setting forth the facts of the case. We give the following summary of results:

The whole length of the proposed canal, from its northern outlet on the Atlantic near Chagres, to its southern outlet on the Pacific near Panama, is 47½ miles; and the distance in a straight line between the two towns is 40·68 miles. The mean level of the Pacific, at the terminus of the line, is 9½ feet above that of the Atlantic, the highest tides in the former rising 20 feet, and in the latter only 16 inches.

On account of the height of the intervening ground, the popular idea of a thorough-cut is out of the question. The natural summit is 10 miles from the Pacific ocean, and 460 feet above it. It is proposed to reduce the summit to a height of 135 feet above the sea, by a tunnel 3⅓ miles in length; and to overcome the remaining elevation by means of 35 lift locks, 17 upon the southern, and 18 upon the northern side of the summit. The tunnel is to be through rock, in the form of a gothic arch, its height being 121 feet, and its extreme width, with a towing path, 69½ feet. By such a reduction of the summit, it is shown that an ample supply of water can be commanded, and a thorough-cut may be substituted for the tunnel, but at an increased expense.

The estimates are made for a canal of dimensions suitable for ships of 1200 tons burthen. The lock-chambers are to be 210 feet long and 46½ feet wide. The width of the canal on the bottom 66 feet, at the water surface 148 feet, and the depth 22 feet. The total cost of the work, including its terminal harbours, is estimated at about twenty-five millions of dollars, and the time required to complete it ten years. The construction of a canal large enough to pass heavy freight in large vessels without transhipment, M. Garella considers to be an object of the first importance; but if, on account of the expense, it should be given up or postponed, he then recommends a macadamized road, which could readily be made, and would furnish great facilities for the transit of passengers and valuable merchandize across the Isthmus.

For the purpose of comparison, it may be well to mention that a proposed route between the two oceans, by the way of the Lake of Nicaragua, was surveyed in 1838 by an English gentleman named Bailey, employed by the government of central America. His results are given in Stephens's *Incidents of Travel*. The natural summit, on this line, is four miles from the Pacific, and 616 feet above it. The fall from the summit to the Lake of Nicaragua is 487 feet in 12 miles, and the whole distance from sea to sea is 125 miles.

The report of M. Garella contains notices of the labours of those who have preceded him in investigating or reporting upon the project of a canal to connect the two oceans; and, in reference to the line by the Isthmus of Panama, his investigations appear to be far more complete than those of any of his predecessors.—*Franklin Journal.*

DRAINAGE OF THE LAKE OF HAARLEM.

At a time when every improvement in the art of Draining, reclaiming, and irrigating land, is an object of national importance, we have

the pleasure of laying before our readers a sketch of the origin and progress of the Drainage of the Lake of Haarlem by the Dutch Government; a work which stands unrivalled in the history of hydraulic engineering.*

At the commencement of the sixteenth century, a number of small lakes occupied a large portion of the Province of South Holland, lying between the towns of Amsterdam, Haarlem, and Leyden. Four of these Lakes, lying contiguous to each other, covered an area of about 15,000 acres; gradually, the barriers of soft alluvial soil that separated them were destroyed by the action of the waters, and the four Lakes became merged into one. The degradation of the shores still continued; until, at the commencement of the eighteenth century, the waters covered an area of 45,000 acres, with an average depth of 13 feet below low water in the Zuyder Zee. This Lake constitutes what is now known as the Haarlem-mer-Meer. The people of Holland saw with much alarm, the rapid extension of its boundaries, and, at an expense of about £33,000, succeeded in partially arresting its progress; but the annual cost of the repairs of the works of defence have for a considerable period amounted to between £3,000 and £4,000. Many projects were proposed for draining the lake; but political and financial causes, and the magnitude of the interests concerned, prevented the execution of any of these plans.

At length, on the 9th of November, 1836, a furious hurricane from the west drove the waters of the Lake upon the city of Amsterdam, and drowned upwards of 10,000 acres of low land in the neighbourhood. On the 25th of December following, another hurricane from the east drove the waters in the opposite direction upon the city of Leyden, the lower parts of which were submerged during forty-eight hours, and 19,000 acres of land were inundated. The enormous loss occasioned by these two storms induced the Government to determine on the Drainage of the Lake: a credit of 8,000,000 florins was voted by the States-General; and in May, 1840, the King, William I., appointed a Commission, composed of eleven members, to superintend the work: their number was subsequently increased, in 1842, to thirteen, under the presidency of M. Gevers van Endegheest, whose father, in 1806, presided over the directorial Commission for the well-known great canal and sea-sluices at Katwyk, by which the surplus waters of the Lake were provided with an outlet to the North Sea. Thus, father and son will have had the honour of presiding over two of the greatest hydraulic works of modern times. Since 1839, a Canal has been cut round the Lake to isolate it from the neighbouring waters, and to afford the means of navigation to the enormous traffic which has hitherto passed over the Lake, amounting to 700,000 tons per annum. This Canal is 37¾ miles long, 130 feet wide on the west side, and 115 feet on the east side of the Lake, with a depth of 9 feet of water. On the side next the Lake, the mouths of all water-courses entering it have been closed by earthen dams, having an aggregate length of 3000 yards, made in 10 feet depth of water.

* This great project will be found noticed in the "Year-Book of Facts," 1841, p. 68.

Other great works have been executed by enlarging the sluices at Katwyk on the North Sea, and at Spaarndam on the River Y, at the base of the Zuyder Zee, where an auxiliary engine of 200-horse power has been placed to assist in discharging the water from the canal during the time of high water.

The water of the Lake has no natural outfall, being below the lowest practicable point of sluiceage. The area of water enclosed by the Canal is rather more than 70 square miles, and the quantity to be lifted by mechanical means, including rain water and springs, leakage, &c., during the time of drainage, is estimated at, probably, 1,000,000,000 tons.

In determining the motive power to be employed, two points were to be kept in view: first, the cost of evacuating the Lake; secondly, the cost of annual drainage; for, when once drained, the site of the Lake can only be kept dry by mechanical power. The annual drainage will probably amount to 54,000,000 tons of water, to be lifted on an average 16 feet; but it may occur, that as much as 35 millions of that amount must be discharged in one month.

With the exception of a few small Steam-engines, the wind has hitherto been the motive power employed to work the hydraulic machines used in the Netherlands to keep the country dry. And the power of 12,000 wind-mills having an aggregate average power of 60,000 horses, is required to prevent two-thirds of the kingdom of the Netherlands from returning to the state of morass and lake, from which the indomitable energy and perseverance of the Dutch people have rescued what is now the most fertile country in Europe.

In 1840, it was found that the average consumption of coals by the Steam-engines used in England and Holland for draining land, *was 15 lb. per nett horse power, per hour.*

The Haarlem-mer-Meer Commissioners were convinced that the old means must be put aside, and new ones adopted to suit the magnitude and peculiarities of their work. Accordingly, they determined to erect three gigantic steam-engines, (from the designs of their engineers, Messrs. Joseph Gibbs and Arthur Dean, of London,) of a peculiar construction.

The first of these Engines, called the Leeghwater, was completed in 1845, and has been experimentally worked during several months. The result has been most satisfactory to the Commissioners: the consumption of coal has been reduced *to two and a half pounds per horse power, per hour, or one-sixth part only of the average consumption of the ordinary draining Engines;* nor has the performance of the Engine, as regards the quantity of water lifted, been less successful; it will raise 112 tons of water 10 feet high at each stroke, and is capable of discharging 1,000,000 tons in 25½ hours.

It is impossible to foresee the future results of this great improvement in the economy of the Steam-engine, for lifting great bodies of water to a comparatively small height: it will completely revolutionise the present system of drainage in the Netherlands; and in the south of Europe and the Tropics may be productive of enormous benefits,

if applied to the irrigation of lands bordering the rivers, which, in the dry season, are frequently ten or twelve feet below the level of the surrounding country.

A short description of the Leeghwater Engine may prove interesting to our readers. It has two steam cylinders, one of 84 inches diameter, placed within another of 144 inches diameter; both are fitted with pistons; the outer piston is of course annular, and the two pistons are united to a great cross-head, or cap, which is furnished with a guide-rod, or spindle; both pistons and cross-head are fitted with iron plates, and together, with parts of the Engine attached, have an effective weight of nearly 90 tons.

The Engine House is a circular tower, on the walls of which are arranged 11 large cast-iron balance-beams, which radiate from the centre of the Engine. Their inner ends, furnished with rollers, are brought under the circular body of the great cap, and their outer ends are connected to the pistons of 11 pumps of 63 inches diameter each; the stroke of both ends is 10 feet; and the discharge from the pumps 66 cubic metres, or tons, of water per stroke.

The action of the Engine is very simple: it is on the high-pressure-expansive-condensing principle.

The steam is admitted first beneath the small piston; and the dead weight of 90 tons is lifted, carrying with it the inner end of the pump balances, and of course allowing the pistons to descend in the pumps.

The equilibrium valve then opens, and the steam in the cylinders passes round to the upper surface of the small and annular pistons; puts the former in a state of equilibrium, and presses with two-thirds of its force upon the annular piston, beneath which a vacuum is always maintained: thus, the down stroke of the Engine, and the elevation of the pump pistons and water, is produced by the joint action of the descending dead weight in the cap and pistons, and the pressure of steam on the annular piston.

The steam is expanded from six to eight times its original volume.

The Engine has two air pumps, of 40 inches diameter, and 5 feet stroke each.

The water is lifted by the pumps into the Canal, from which it passes off towards the sea sluices.

The total weight of iron employed for the Engine, pumps, &c., is 640 tons.

The cost of the machinery and buildings, £36,000.

Two other Engines of equal size and power are now being constructed by Messrs. Harvey, of Hayle, and Messrs. Fox and Co., of Perran, in Cornwall, who also manufactured the Leeghwater: no higher encomium can be passed upon those Establishments, than the simple fact of their being entrusted with the manufacture of these, the three largest Engines in the world.

The united action of the three Engines will discharge about 2,800,000 tons of water per twenty-four hours; and, allowing for contingencies, the Lake will be pumped out in about 400 days, at a total cost, including the price of the Engines, buildings, &c., not ex-

ceeding £140,000. By the old system of Steam Engines, the cost would have exceeded £240,000; and to do the same work in four years by wind, would require 114 first-class windmills, at a cost of £308,000. The annual cost of keeping the Lake drained by wind would have been £6,100; by the old system of steam-engines, £10,000; and by the improved system, will be £4,500.

It is worthy of remark, that it would be almost impossible to carry out this project for irrigating 45,000 acres, had the old and expensive system of steam-engines and hydraulic machinery been employed in draining the Lake; for the coal cost alone, for the Engines to lift the waste sewage water out of the "Polder," would amount to £13,000 per annum; whereas, by the system adopted, it will only be £2,200. —*The Illustrated London News*, No. 232.

NEW FORTIFICATIONS AT GOSPORT.

The new works at the Blackhouse Fort, on the Gosport side of the harbour, are rapidly progressing towards completion, and will be of a very formidable description. On the side facing the sea is a double tier battery for 26 eight-inch guns, 14 of which are already mounted, commanding the anchorage of Spithead; while that part of the fort which is parallel to the harbour is well defended by a strong tower and numerous loopholes for musketry. The number of guns will be, in all, about 56, very few of which will be less than 32-pounders, and the greater part of still larger calibre. Commodious barracks for five officers and a hundred men are in the course of construction. All the new buildings within this fort are bomb-proof. At Pridday's Hard, on the same side of the harbour, the powder magazine and ordnance station, hitherto almost unprotected, are undergoing such extensive alterations as will render them an extremely strong position. The lines round Gosport, Portsea, and Portsmouth, which have been for some years nearly disarmed, and in many places suffered to fall into decay, are being repaired and put into a state to receive a very large and powerful equipment of ordnance. A new and beautiful battery for six guns, in the ravelin of the Spur Gate, is already finished. It is provided with magazines, storehouses, and all the other requisites, and is most perfect in its arrangements. Southsea Castle, now used as the military prison of the district, is mounted with thirty-two guns, thirty-twos, and twenty-fours, and we hear that it is intended further to increase the artillery of this important post. Alterations on a very large scale are in contemplation for the works at the entrance of the harbour on the Portsmouth side. According to the projected plan, a double tier battery will occupy the space of the present saluting battery, from which seventy guns, by crossing their fire with those of the Blockhouse Fort opposite, will render it perfectly impossible for any vessel to force its way into the port.

DREDGE'S BRIDGE OVER THE MOYOLA.

We quote from the Bath Journal the following description of *Bridge* on Mr. Dredge's system, which he has recently erected

over the river Moyola, near Castledawson, county of Derry, the seat of the Right Hon. G. Dawson:—

"The bridge is a curious structure: it is 86 feet span of a single wing, or bracket, extended over the river, which rests upon masonry on the high ground, and dips to the other side, which is seven feet above the water's summer level. The chains are securely fixed back in the high ground, and the roadway line tied on the other side into the lower level, which compels each side to perform its respective work; the roadway keeping the chains extended, and enabling them in the easiest possible manner to sustain and convey the weight of the bridge and its load to the top of the pier of masonry,—the grand fulcrum of the bridge; and this it is which admits of the great diminution in the chains, namely, from twenty-four links at the base to two links on the other side of the river, occasioning, as it does, no waste of power, labour, or material, and affording a most clear exemplification of the truth of the principle upon which it is constructed. The iron-work of the bridge is considerably under five tons weight, and it was transmitted from Bath to Castledawson, in the north of Ireland, a distance of 400 miles. On its journey, it was detained in Dublin two days, and one in Belfast, and the heavy floods obstructed the works three days; yet, after all, the bridge was completed in sixteen days from the date the iron-work was sent from Bath, the masonry inclusive. In the erection, it occupied but six ordinary days of labour for sixteen men, who were all strangers to the work."

THE DOUBLE-ACTION PRINTING MACHINE.

This Machine has been invented and patented by Mr. William Little, of 198, Strand; and its success is considered by several eminent engineers and printers to be established by the working of a beautifully constructed model, of three inches to a foot.

To explain the advantages of the new Machine, especially to the reader unacquainted with Printing Machinery, we should premise that, by "the Fast Machine," such as is used for printing the daily newspapers, the impression is obtained by Four Cylinders, two of which revolve constantly in one direction, and the remaining two constantly in an opposite direction: thus, only two sheets of paper can receive an impression from the "form" of type with each passage of the table,—the cylinders, when giving the impression, necessarily travelling in the same direction as the table; hence, although the form passes under the four cylinders, two of these are alternately idle, and the machine consequently produces only *two* printed sheets with every backward and forward motion of the type.

The *Double-Action Machine* works with *Eight Cylinders*, six of which have a reversing motion, and it produces *seven* printed sheets with every transverse motion of the type. Thus, in the "Fast Machine," only half the *cylinders actually* print alternately, whilst in the latter, *seven out of eight of* the cylinders are constantly at work; so *that, supposing both machines to* have the same number of cylinders, *the Double-Action Machine* would, from this circumstance alone,

produce nearly twice the quantity of printed sheets; but on comparison it will be seen that considerably more than twice the number can be produced.

The surface of the type, it is known, rests on an horizontal table, which is moved backward and forward by a pinion working in a rack beneath the table. This rack, terminating at each end in a semicircle of a certain diameter, has consequently, besides its traversing motion, a lateral motion, at the time of which the progress of the table may be considered as neutral, or, in other words, the operation of printing is at a " stand-still " until the pinion has passed round the end of the rack, causing a considerable loss of time during several thousand revolutions. Thus, to print *twenty thousand* sheets by the present "*Fast Machine*," the pinion must pass *five thousand times* round each end of the rack, which, with a rack of six inches diameter, is equal to a space of 15,000 feet.

To print *twenty thousand* sheets by the *Double-Action Machine*, it is evident that, as SEVEN sheets are produced from each passage of the table, the pinion will have to pass round each end of the rack only *fourteen hundred and twenty-eight* times, equal to a space of 4284 feet, or 10,716 feet less than in the Fast Machine.

Another source of gain in the *Double-Action Machine* arises from the cylinders being diminished in size, and by working them as closely together as possible, the present four-cylinder machine requiring a rack of *six feet*, whilst the *Double-Action Machine*, with twice the number of cylinders, requires a rack of only eight feet,* which, multiplied into the number of revolutions required to work *twenty thousand* copies, is about equal to *five thousand seven hundred and twelve* feet. We have thus far briefly explained in what consists the difference between the *Double-Action Machine* and the present machines.

When the present *Fast Four-Cylinder Machine* was introduced, it was thought a great achievement to have doubled the number of cylinders, and a further advantageous increase to their number was regarded as impossible. It was, therefore, necessary to adopt some entirely new arrangement to admit of more cylinders being brought into operation, or to make it possible that half the number of cylinders employed should not remain idle alternately: or, in other words,—

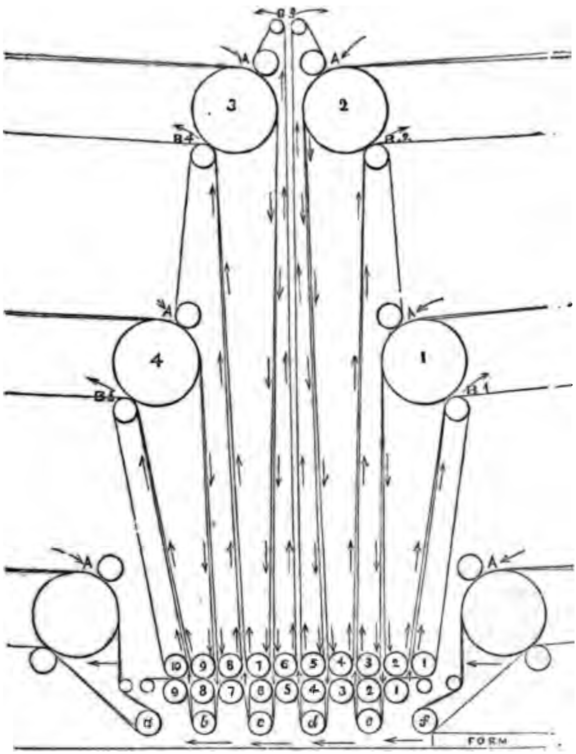
1st. To increase the number of cylinders, and to make them work backward and forward, each in its turn producing a printed sheet, with every passage of the form of type.

2d. To present the paper to be printed at the exact instant required, and afterwards move it out of the way for the next coming sheet.

The most important and difficult part of the problem was the latter. We could imagine fifty or a hundred cylinders in full play, with the type passing under them at great speed, each cylinder being ready *charged* with its sheet of paper; but how these cylinders were to *receive their next* supply of paper at the exact instant required, and

* *The entire* length of traverse in two of the Times Machines is 6 feet 7 *inches; in two others*, 6 feet 2¾ inches.

how the printed sheet was to be cleared out of the way, was a difficulty immensely increased when it was considered that each cylinder must receive a sheet on each side alternately, as will be understood by the annexed diagram.



It is evident that, as the cylinders of the *Double-Action Machine* work backward and forward, continuous tapes cannot be used for connecting the printing cylinders with the feeding drums, and revolving with them constantly in one direction. In the diagram, the tapes passing round the drums, 1, 2, 3, 4, have no connexion with the tapes passing round the printing cylinders, *b*, c, *d*, e ; the purpose of the former being to conduct the sheet to the cylinder, and afterwards to receive and carry the printed sheet away. The diagram represents

the internal arrangement of a *six-cylinder* machine, producing five printed copies with each backward and forward motion of the table, the form of type being shewn at one extremity, proceeding in the direction indicated by the arrows.

We will now trace the passage of the several sheets, commencing with that which passes direct to *e*, the first of the reversing cylinders. The sheet enters on the drum 1 at A; it is then conducted to the feeding rollers, 2, 3, and passes from them to the cylinder rollers, 1, 2, and next round the cylinder *e*, where it meets the form of type, and receives an impression; it is then conducted by the cylinder tapes through 2, 3, to the takers-away, 3, 4; thence it passes in the direction of the arrows to the point B 2, when it falls on a single continuous tape, and is carried to a receiving box. The next sheet enters on the drum 2, at A, passing, as before, in the direction indicated by the arrows, to the printing cylinder *d*, and ultimately at the point B 3, when it is again carried by single tapes to a receiving box. The next sheet enters on the drum 3, and proceeds as before to the cylinder *c*, arriving at B 4; and the next sheet on the drum 4 to the cylinder *b*, coming out at B 5, &c. So soon as this last sheet has cleared the cylinder-rollers 8, 9, the whole of the feeding and taking-away rollers are made to slide, bringing the same figures over each other: thus, 1 over 1, 2 over 2, &c.; the printing cylinders being at the same time reversed, revolve in a contrary direction. It will be observed, the feeders are now in a position to deliver a sheet on the other side of the cylinders: indeed, the whole operation is so simple that a careful study of the diagram is alone sufficient to explain the theory of the *Double-Action Machine.*

We have made no allusion to the working of each of the end-cylinders, since they revolve only in one direction, and are lifted alternately, as in the old system. Our description, however, would not be complete without explaining why we combine the old system with the new, since this combination is an important feature in the invention.

It has been stated that the *Double-Action Machine* has eight cylinders, and that seven printed sheets are produced from each passage of the types. Of these eight cylinders, six only have a reversing motion, or revolve backward and forward; each of the end cylinders lifts and revolves constantly in one direction, like the cylinders of the present "Fast Machine." The reason why the end cylinders differ from the other six is this: in consequence of the reversing motion of the six cylinders, it is necessary that a certain interval of time should elapse to allow the sheet in work to get clear off before the next sheet can be allowed to enter. To effect this, the table must traverse a certain distance beyond the extreme vibrating cylinder; and advantage is taken of this space to place a lifting cylinder, which does not require the type to pass beyond its centre,—thus giving one sheet more from each end of the machine, amounting to 2856 during the working of 20,000 sheets. This will explain how seven sheets only are produced from eight cylinders, each of the

end cylinders producing only one sheet, whilst the remaining six produce two each, from one revolution of the rack or table.

We conclude with an abstract of the several powers of the *Double-Action Machine*, working, as it may be, with one or more reversing cylinders.

We simply give the number of combined cylinders at work, the length of traverse, the speed per second, and the result from two rates of going, viz. four and five feet per second:

CYLINDERS.		LENGTH OF TRAVERSE.	SPEED PER SECOND.	NO. OF SHEETS PRINTED PER HOUR.
3	2 Constant 1 Reversing	5 Feet	4 Feet 5 —	5,760 7,200
4	2 Constant 2 Reversing	6 —	4 — 5 —	8,000 9,000
6	2 Constant 4 Reversing	7 —	4 — 5 —	10,000 12,000
8	2 Constant 6 Reversing	8 —	4 — 5 —	12,600 15,750

The average length of traverse of the present "Fast Machine" is six feet six inches, and the average speed, four feet per second; the average number of copies printed, 4500 to 5000 per hour.

In the new machine, the process of inking the form is effected in the usual manner by composition rollers placed between the cylinders.

The quality of printing will be improved by the new machine, since the rate of going may be diminished to one half, and the amount of produce still exceed that of the present "Fast Machine."

The "register" will be much more perfect, since six out of eight of the cylinders are not disturbed by lifting; from which the tapes are always running at the same tension, and never slackening.

The quality of the inking will be superior,—the inking-rollers, from the increased length of the table, having more time for distribution.

The feeding, or laying on, will be slower and more certain, since at each drum, arrangement is made for a double laying-on. Thus, it will be seen, increased speed is not gained at the expense of quality in execution, but with its manifest improvement.

The beautiful working model has been made by Mr. Lewis Foster, engineer; and one thing worthy of remark, and we might say without parallel, in the history of mechanics, is, that the principle of the inventor has not undergone the least alteration from the commencement; and that in the construction of the model, no experiment has been necessary, and not a single wheel or motion has been wasted. The very first trial was successful. Since then, many thousand sheets have passed through the machine, as evidence of its perfection in principle and construction.—*Illustrated London News*, No. 238.

Upon this valuable improvement, the Editor of the *Mechanics' Magazine* observes:—"But thirty-two years have elapsed since the proprietors of the *Times*, which was the first newspaper printed by a steam-press, boasted *'that no less than eleven hundred sheets were impressed (by it) in one hour.'* It was regarded by them as a feat *quite unparalleled, and never*, in all human probability, to be excelled.

What a wondrous change have a few years effected! By the persevering ingenuity of Napier, Cowper, Dryden, and others, the number of impressions was increased about four-fold; and now Mr. Little has carried the increase to nearly four times four. Such giant strides as this in art are only to be made by giants in genius. The introduction of printing by moveable types was scarcely itself of more importance than this. It increased amazingly the capabilities of the typographical art, but not for a long time to anything like the extent which Mr. Little's machine promises to do before another year passes over our heads. Kœnig's name stands deservedly high as having been the first to apply steam power to the art of printing; but equally high, if not higher, should stand the name of him who by his mechanical skill has enabled steam to do three times more for the art than Kœnig ever realised, or, most probably, ever dreamt of."

HILL'S PATENT PRINTING PRESS.

THIS is a very ingenious invention, by which, by means of hand labour, and without the aid of steam power, a hand printer is enabled to produce impressions with a rapidity far beyond anything that the hand-press or any press not worked by steam has hitherto produced. The small printer cannot of course use the steam press: the machinery, from its bulk, complexity, and great expense, is beyond his means; any invention therefore which tends to facilitate and expedite his labours, is important, and worthy of his inquiry and regard. The dimensions of this machine, though it can multiply copies in the *ratio of four to one over the hand-presses in general use*, do not exceed those of the common press. Its simplicity of construction is also a great advantage, for it has neither tooth-wheel, rack, or pinions for giving motion; neither has it the tapes for conveying the paper. A strong lad can work off from 1200 to 1500 impressions per hour with less labour and exertion than is required by the common hand-presses to work off 300 impressions.—*Times*.

We heartily concur (says the Editor of the *Mechanics' Magazine*) in all that the *Times* has said in its individual praise. It is beyond all question at once the simplest and most powerful machine of its class which has yet appeared.

Motion, it will be observed, is given to the machine by means of a treadle, which the pressman works with his foot, whilst his hands are employed in laying on the sheets; but this is an arrangement intended to be confined to presses for small work: in presses of larger dimensions it is proposed to use hand-wheels. In establishments where steam power is employed, a number of these presses might be driven by an over-head shaft, with very little power, and perfect convenience.

Originality cannot of course be claimed, and is not claimed, either for producing the impressions by cylindrical pressure, or for the mode *of working* the cylinders, in both of which respects Mr. Hill's press *differs in little, if* anything, from the (now) common steam-press. *The chief novelties* in this press we conceive to be these: first, the *peculiar arrangement* for moving the type-table; and second, the

apparatus for taking off the sheets when printed. In both of these respects, the simplicity of construction and working efficiency of the machine are such as apparently to leave nothing more in the shape of improvement to be desired.

The manner in which impressions are taken is as follows:—The form of types being fixed and made ready for printing, and motion being given to the wheel, the pressman connects the motion of the wheel to the axis of the printing cylinder by a sliding clutch; he then lays a sheet on the register-plate, with its front edge and one of its ends in contact with a guide, and, on the printing cylinder arriving at a certain position of its revolution, the front edge of the sheet is secured to the cylinder by claws, which carry it round to meet the types and receive the impression. By the time the impression is completed, the cylinder has brought the front edge of the sheet within the claws of the removing-arm, which claws then close and secure the sheet, and simultaneously beneath, the cylinder claws open, and allow the sheet to pass from the cylinder by the removing claws, and to be deposited on a shelf ready for being removed by hand.

On the end of the cylinder spindle outside the frame, there is a crank-arm, which pushes back the type-table after an impression has been taken; and, on its arriving at its most backward position, the crank-arm quits its connexion with the table, and a connexion takes place between the end of the printing cylinder and the edge of the type-table, by which means a firm contact takes place between the two surfaces, which produces the forward motion of the tables and types to produce the impression.

The supply and distribution of ink are effected by the table and types running under the inking rollers, in the ordinary manner of steam printing-machines.

CASTING AND RAISING OF THE GREAT WELLINGTON STATUE.

We quote from the *Illustrated London News*, No. 231, the following interesting details of this vast work, derived from the Artists engaged, and other accredited sources:—

The stupendous Statue has been entirely executed at Mr. Wyatt's studio, Dudley Grove House, in the Harrow Road. The group was modeled by Mr. Wyatt, and his son, Mr. James Wyatt, who studied under his father, and has lately completed a very picturesque equestrian statue of her Majesty.

The model was commenced in May 1840, and occupied the Artists upwards of three years. The plaster of Paris used in the stupendous work considerably exceeded 100 tons: it was formed upon a turn-plate, or revolving platform, upwards of 20 feet across, travelling upon 40 rollers, and weighing, in itself, several tons. The vastness of the model required certain precautions to insure its entireness: thus, to give strength to the body of the horse, a beam passes through it longitudinally, *like a back-bone*, from which spring transverse timbers, *like the ribs of a ship*. From the body of the horse was a line of

iron bolts, beneath which, in the early stage of the modeling, were placed props for security in shifting the figure by means of the platform, so as to obtain the most desirable positions for light, &c.

In order to reach the different parts of the model, a travelling stage, with a shifting floor, was constructed, so that it might be adjusted to any height.

The entire group, we should here explain, represents the Duke of Wellington as he appeared on the Field of Waterloo, upon his favourite horse, "Copenhagen," in a standing position. The Duke sat to the sculptor for the portrait; the head is remarkably fine, and the likeness good: the warrior wears his customary short cloak, which the artist has skilfully draped, so as to give it something of the grace ol classic costume.

The general practice of casting statues need not be detailed here. The material is bronze—a compound of zinc, copper, and tin. For melting it, Mr. Wyatt erected two great furnaces; the first employed was capable of melting only twelve tons at a time, whereas, it was found desirable to cast the remainder of the statue in larger, and, consequently, fewer, pieces; a second furnace was, therefore, built, capable of melting twenty tons at a time.

The mould and core being placed in the pit in the foundry, the bronze was run into it from the furnace; and the body of the horse, and the lower portion of the rider, were thus cast in two portions of about twenty tons each. These were magnificent castings; and the effect of so large a surface of molten compound as the twenty tons presented, is described as very extraordinary. The statue, or rather group, was thus cast in about eight pieces. In each case, the mould was placed in the pit imbedded in sand, rammed in as tightly as possible; yet, in casting the front of the horse, by some means, six tons of metal escaped through the mould; the chest of the horse was left vacant, and the casting was consequently spoiled. In order that the legs of the horse should be capable of carrying the great weight they would have to sustain, it was found necessary to cast them solid. The other portions of the work vary from one to three inches in thickness, with strong ribs internally, to give additional strength. It is computed that the whole group cannot weigh less than forty tons. Its height approaches thirty feet; and such is the bulk of the horse that eight persons have dined within one half of it. The following are a few of the other main dimensions:—

	Ft.	in.
Girth round the horse	22	8
Ditto, arm of	5	4
From the horse's hocks to the ground	6	0
From the horse's nose to the tail	26	0
Length of head	6	0
Length of each ear	2	4

The group being cast in pieces, as above, they have been joined, *partly by screw-bolts,* two inches in thickness, and partly fused to-

gether by a new process, twelve inches at a time; whereas, by the old method, only six inches could thus be fused at once.*

In consequence of the colossal size of the group, there were, for some time, upwards of thirty men employed at once upon the bronze; and, in case of any work being requisite to be done within the figure of the rider, the head was removed, to allow the workmen to descend through the neck. The cleansing, chasing, and finishing, occupied a considerable time.

It has been stated that the statue is composed of the brass of guns taken by the noble duke, in his various campaigns, and contributed by the Board of Ordnance for this purpose. Such, however, according to the *Literary Gazette*, is a mistake for what ought to have been, instead of what truly was. One gun was given by the Ordnance to cast the head; and from 3 to 4 tons of the rest of the 40 were contributed on a division of what was left from the City statue, between the Nelson-monument in Trafalgar Square and this, "the Wellington Group."

The group was conveyed from the Harrow Road to the Green Park Arch, on Monday, Sept. 28th, and raised to the pedestal on the arch on the following Wednesday. A body of riggers from Woolwich Dockyard, under the direction of Mr. M'Mullens, assisted by a number of labourers, were first occupied in changing the position of the statue, as deposited the day before, from south to east; and in order to accomplish this end, the whole mass of figure and carriage, weighing altogether sixty tons, was lifted by the tackle, and then shifted into the desired spot. This feat fully proved the competency of the mechanical appliances provided to perform the allotted task: accordingly, the preparations were carried on until three o'clock, when the signal was given to "hoist away." The figure was raised by means of strong six-inch cables fastened round each arm, or thigh of the horse, which were then hooked on to the blocks used in the ascent. Through these blocks, four in number, triple sheaved, and expressly made for this occasion, ran six ropes, also quite new, and made of the strongest yarn, each rope being calculated equal to ten

* The *Literary Gazette*, last spring, contained the following upon this "remarkable fact in Metal Casting:"—

"We have from time to time described the progress made by Mr. Wyatt in casting the stupendous Wellington equestrian group, the largest work in bronze ever executed, and we think one of our latest notices was that of a party of eight having dined conveniently within the cavity of the horse's hind-quarters. But after all that had been done, there came an operation of unexampled extent, difficulty, and uncertainty. This consisted in the uniting together by fusion of the two great divisions in which the horse had been cast. A few inches is perhaps the limit hitherto of such a work; but here there must be a girth of molten brass (several tons), to the length of twelve feet, poured into the junction in such a manner as to fuse each adjacent side, and combine the whole into one solid mass. The contrivance of a mould for the reception and application of the run from the furnace was exceedingly ingenious, and, as the experiment turned out, perfectly successful. From the belly to half way up the sides the horse is as completely united as if it had been cast in one piece; and the upper portion of the body will offer no obstacle like that which has been overcome in the inferior portion of the circle."

tons. Upon the traversing platform above, were four "crabs," or powerful windlasses, worked by eight men each. The scaffolding, erected for the purpose by Mr. W. Ellis, (of Park-place, Paddington,) under the direction of Mr. Wyatt, was of itself 115 feet in height; having taken upwards of 200 loads of timber in its construction, besides scaffold poles and planks.

The removal of the various fastenings and bolts by means of which the statue was secured to the car, occupied no less than six hours, viz. from nine A.M. to three P.M. At a quarter past three, the statue having been properly secured in the slings, began slowly to move. On mounting to the platform on the summit where the men were engaged in working the "crabs," it was curious to observe how slight was the manifestation of force employed in the important operation. Eight men at each "crab" sufficed to work it, two additional men being employed in holding and coiling the rope as it wound off the machine. Thus, thirty-two men were enabled, by the united leverage of the four "crabs," and corresponding "falls," to raise considerably more than a ton each, they being placed at a height of one hundred and fifteen feet above the object which they were lifting. The operation proceeded with great caution on the part of Mr. Ellis and his assistants; and no accident of any description occurred. At six o'clock, the statue was raised to the height of about forty feet, having gone up at the rate of three inches every minute during the two hours and three quarters that were consumed in the process, as far as it had been achieved.

Meantime, the shades of evening were gathering round, and subsequently night fell in. The moon soon after arose; and, though clouded in the commencement of her career, shone brilliantly.

The riggers, who had for some time disappeared from the scaffolding, now again began to mount the ladders and "man the yards;" and, soon after, the large moveable platform aloft, on which were the windlasses, by which the statue was carried up, commenced its horizontal locomotive efforts; and, before nine o'clock, the platform, statue, and all, had been backed westward, and fairly landed on the proposed site.

On Thursday morning the masons and other workmen resumed their labours; and at one o'clock, the grooves, in which the large bolts that project through the feet of the colossal horse fit, being pronounced by Mr. Wyatt to be sufficiently complete to admit of the figure being fixed, orders were given to the persons who had the management of the traversing machine to proceed with their operations; and in a few minutes afterwards, Mr. Wyatt, and the members of the Committee who were in attendance, had the gratification of seeing the statue move steadily, and without the slightest accident occurring, into its destined position. Immediately after, the work of securing it was proceeded with, and in a very short time the figure was firmly fixed.

We should add, that, for the removal of the group, was constructed a huge car, weighing about twenty tons, and consisting of a strong platform upon four equi-circumferential wheels, ten feet in diameter;

the two front-wheels having radiating cast-iron spokes, open; and the hind wheels being covered with sheet iron, somewhat convex in form, and bossed, so as to remind us of an immense ancient British shield. The statue was slung within this frame or platform, the feet of the horse resting upon ledges, a short height from the ground, thus sinking the weight so low as to preclude all danger of oversetting.

THE GREATEST IRON GUN EVER CAST.

On the 8th of July, 1846, another stupendous piece of ordnance was cast at Alger's Foundry, South Boston, which, when finished, will exceed Captain Stockton's celebrated "Peacemaker" by 5000 lbs. in weight. The quantity of metal used was about 46,000 lbs., and the amount of coal consumed in reducing it to the requisite state of fusion, was eight chaldrons. The casting was done under the personal supervision of Mr. Alger and Col. Bomford, the inventor of this species of ordnance, to the first specimen of which, Thomas Jefferson, 1809, gave the name of the "Columbiad." The weight of the gun when finished will be 25,000 lbs. Length, 10 feet; diameter at the base ring, 39 inches; length of chamber, 13 inches; diameter of chamber, 9 inches; length of bore, 9 feet 1 inch; diameter of bore, 12 inches. Weight of round shot which it will carry, 230 lbs.; weight of shell, 180 lbs. Range of shot or shell, 3½ miles, being one-quarter of a mile greater than the recorded performance of the largest and latest invented mortar in England, and half a mile beyond the reach of any gun in the castle of San Juan de Ulloa, at Vera Cruz. The cost of this immense instrument for harbour defence will not exceed 1700 dollars, or one-sixth the cost of the wrought-iron gun procured in England by Captain Stockton.—*Boston Post.*

[The last "greatest gun" cast in the United States, burst when first tried, killed the Secretary of the United States' Navy and several other persons.* We trust the present will be more fortunate. The "iron gun" referred to as having been "procured in England by Captain Stockton," is one now on board the American steamer *Princeton*, which was cast by Messrs. Fawcett, and Co. of Liverpool. It discharges shot of 219 lb. weight.†]—*Mechanics' Mag.* No. 1201.

NAVAL GUNNERY.

Some interesting Experiments have been made at Portsmouth, on the most speedy and efficacious mode of destroying a boom, which might impede the progress of boat squadrons in narrow rivers, as in the case of the late attack on the pirates of Borneo, by the squadron under Rear-Admiral Sir Thomas Cochrane.

On one occasion, says the *Times* report, two line-of-battle-ships' lower masts were taken from the old mast pond and moored at a short distance from the Excellent. Six turns of small chain lashing secured the two spars in the *centre; the* ends of the spars were secured by *two half hitches of chain,* and two parts of the chain cable ran along

* *See "Year-book of Facts," 1845,* p. 60; and 1846, p. 50.
† *Ibid. 1844, p. 54.*

the spars, and were secured in the same manner round the opposite extreme. The spars being thus secured, as if at the entrance of a river or creek, to prevent intrusion, the operations now commenced to dislodge them:—A breaker, containing 56 lbs. of gunpowder, was brought to the spot; at one end were eight inches of port-fire passed into it, over which was secured a copper tube made perfectly water tight: two threads of quick match being attached to the upper end of the port-fire, and the opposite extreme brought through to the mouth of the tube above the water, they were ignited, and the breaker being thereupon hauled and secured immediately under the spars, a sufficiency of time (8 minutes) was provided for the boat to get clear of the mass before the port-fire reached the powder, which it did in the time above mentioned, when a tremendous explosion took place. On examining the spars and their fastenings, afterwards, the following was the result:—14 feet out of the centre of both spars was shivered into atoms, with one of the chain lashings blown up with the timbers. The same experiment was afterwards repeated upon the shorter end of the obstruction, under the parts of the chain cable, the result of which was that the whole of the spars were blown to pieces. These experiments were highly successful and satisfactory.

Next morning, a further experiment was made upon the two long ends of the same spars, with the chain-cable wound round them, and a hemp (13-inch) cable hove "taut" in the intervals, the rest of the arrangements being the same as the day before, except the quantity of powder, 112 lbs. being used to-day. The result was the total demolition of both spars; the chain cable was thrown to the bottom, and the hempen one blown away. Thus the success of the experiments was most unqualified and important. They were performed at the desire of Lord Ellenborough, who had expressed to Captain Chads, in a letter, his opinion upon the importance of naval officers becoming acquainted with the safest and most speedy method of removing such obstructions as those offered to the China squadron on the late occasion of the conflict with the pirates in the Malvodo river. Captain Chads personally superintended the operations of the respective experiments, which were executed by Lieutenant Robert Jenner, gunnery lieutenant of the Excellent, in a manner highly creditable to the talents and ingenuity of that officer.

EFFECTS OF SHOT ON IRON VESSELS.

EXPERIMENTS respecting the effect of Shot on Iron Vessels have been made at Woolwich in the presence of Sir George Cockburn and Sir W. Gage, when it was ascertained that a 32-pounder could send a shot clean through an iron plate much thicker than that used in the construction of steamers; but the results were such as, it would appear, to justify that distinguished officer, Sir George Cockburn, in permitting the present iron-steamers building to be proceeded with. "Some remarkable results have also been produced by the shot practice from the Excellent on the Ruby iron steamer, ordered by the Admiralty to be experimented on, in order to test what resistance the iron hull of a ship

would offer to a shot; and it is expected that the Admiralty will in consequence stop the building of iron-steamers and other vessels for the present. The shots which struck the Ruby not only penetrated the sides first struck, but in several instances passed through the other side, carrying with it whole plates of iron. In action, this would risk the total loss of a vessel, for on heeling over to leeward, such a body of water must rush in that she would inevitably sink with all on board. A representation of this important result has been made to the Admiralty, and should further experiments prove that serious risk will be occasioned to iron vessels of war when exposed to the chance of being struck by heavy shot, it is doubtful if the Board will not abolish them as men-of-war." This is absurd: the experiments against such a rust-eaten old iron trough as the Ruby, prove nothing but that the Admiralty were quite right in making a target of her, when they could get no one to buy her for £30.—*Nautical Standard.*

FOULERTON'S SHIP-MANŒUVRER.

The object of the Manœuvrer is not to supply the place of the rudder, but to assist its operation whenever its power is insufficient; and to do its duty when it is disabled by accident, or rendered useless from the ship having no way.

The manœuvrer can be worked either by steam, winch-handles, or by a rope led along the deck and triced up when done with.

The *principle* of the manœuvrer is simply that of a submarine propeller, which drives a ship across the Atlantic, and will likewise drive one round upon its own axis; this end being attainable by a very small propeller worked by a few of the crew, which constitutes the immense physical force always on board a man-of-war, and generally unemployed at the moment the manœuvrer would be required. Subjoined are some of the advantages that would be derived from its use.

The head of the vessel directed to any point, when the rudder does not act owing to the vessel having no way, or when the action of the rudder is insufficient.

The vessel brought about, when the rudder fails in stays, or wore short round, under bare poles, without running to leeward.

The vessel kept from coming up in the wind or falling off, when lying to.

The head brought round in sudden shifts of wind, or when taken aback, and when there is no time to get a boat out.

The constant bracing about in baffling winds avoided by bringing the breeze on either side.

The ship put before the wind in sudden squalls.

The head always kept to the course in a calm, so as to keep station in a fleet or forge a-head.

The head brought round, to prevent fouling among craft and shipping, and the use of boats and warps saved on various other occasions in river ways and harbours.

The vessel worked with safety and certainty to an anchorage, swung at achor in calms to keep clear hawse, and cast when getting nder r ay.

The vessel brought about in light winds without losing her headway, an important advantage in chase, especially when beating to windward in short tacks; for by being brought up quickly head to wind, (with a turn of the manœuvrer, on putting the helm down,) she would shoot ahead in stays, "haul of all" and be on the other tack, while her opponent would always have to break off after coming about to gather way and luff to her course, losing both time and ground.

Steam shipping enabled to wind with safety and dispatch, particularly in rivers and narrow harbours.

The principle of the invention has been fully proved in the vessels which have been fitted with it, and the following facts are ascertained:—

That a screw, such as was fitted in the Stockton Collier, H. M.'s Lighter and the St. Lawrence frigate, may be placed in the dead wood of any ship, *without weakening the construction, affecting the speed, or causing any obstruction or detriment.*

That there is scarcely a possibility of its getting out of order, the Stockton having run through a severe winter without the slightest injury to any part of it, and without her rate of sailing having in any degree been impeded.

That it has also the advantage of doing no injury to the ship if it should get out of order.

That it gives out nearly all the power applied to it, two men at the winch-handles of the St. Lawrence having worked it to its full speed in the dry-dock at Sheerness; by which it is proved that the manœuvrer gives a power on board, according to the number of hands applied to it, equivalent to the power produced by placing the same number of hands in boats or on shore at a minute's notice, to tow or haul the vessel round by rope.—*Inventor's Pamphlet.*

CAPTAIN BEADON'S CANAL WARPING SYSTEM.

Some remarkably successful trials have been made on the Regent's Canal, of a new system of propelling, patented by Captain Beadon. It consists in the combination of the power of Steam with the mode of Warping, so well known to all nautical men. In the middle of a flat-bottomed barge, with a prow and rudder at both ends, (*Janus* fashion,) there is placed a steam-engine, the power of which is transmitted to two rollers mounted on bearings, one at each end of the boat, which are alternately employed in letting out and drawing in a wire rope, either laid along the bottom of the canal, or carried from the boat to posts on the towing-path.

Thus, there are merely the engine-reels, and fore and aft haulage ropes; one of the latter in the act of being wound upon its reel, and thereby dragging the boat forward, and the other in the act of being *unwound*, and thereby keeping the boat steady in the line of motion. It is proposed to employ as great lengths of rope as can be conveniently wound upon the reels; and according to these lengths will, of course, be the distance gone over with each set of ropes. As we have said, the ropes may be either attached at their far ends to posts

on the canal or river banks, or they may be laid down loosely in the bed of the canal or river—the weight and friction against the ground, of a rope a mile or so in length, being such as to afford quite resistance enough to the pull of the engines. The latter arrangement, however, is of necessity one which can only be conveniently adopted where there is but one length of haulage to be performed, and that of no greater length than the reels are equal to; as, for example, between lock and lock, or from one end of a tunnel to another.

Where this system of warping has to be kept up continuously for a great many miles, the inventor proposes to have a series of posts fixed at regular distances along the banks, with a warp attached to each; that these warps shall be taken up successively and wound upon the reels; and that as each warp is drawn in, the reel on which it has been wound shall be thrown out of gear with the engine, and the warp left free to run out towards the rear, while the other and now empty reel is brought into action to pull in the next warp of the series.

In the experiments made, several heavily-laden barges were drawn by the steam-tug with ease at the rate of between five and six miles an hour. Of all the plans that have been recently brought out in aid of the declining canal interest, this seems by far the most promising.

The economy of this system of haulage, as compared with that of horses, can hardly be doubted. It resolves itself, in fact, into one of the simplest and cheapest of all known modes of applying power; viz. that of drawing, by direct leverage, a weight over a pulley.—*Mechanics' Magazine*, Nos. 1202 and 1203.

PARKER'S WATER-WHEEL.*

THIS Wheel by Mr. Parker consists of an annular space included between two concentric cylinders, and closed above and below. This space is divided into compartments by means of curved partitions or paddles, against which the water acts to turn the wheel. The wheel is mounted upon an axis, either vertical or horizontal, and the water is introduced into the interior by means of a spiral inclined plane or helix, by which it is delivered at the inner circumference of the wheel, very nearly in the direction of the tangent to its motion. The curve of the buckets is so laid down, that the water issues from the external circumference with no more velocity than that necessary to clear it from the wheel.

The whole wheel and its helical sluice are introduced into an air-tight box, called by Mr. Parker "a draft," or "draft-box," which is kept perfectly tight by being immersed in the penstock, and into which water can find admission only by passing through the wheel; proper arrangements being made for carrying off the water as fast as it is delivered by the wheel.

Mr. Parker's *wheel is a true* wheel of pressure, or "turbine," in

* *Extract from a Report thereon of* Committee of the Franklin Institute, *June 11, 1846.*

which the helical sluice has been substituted for the curved guide placed by M. Fourneyron in the interior of his wheel: it might therefore be expected that, provided the curved paddles of the wheel be properly constructed, the practical coefficient would approach, at least, that given by the ordinary turbine; and the experiments tried by the Committee have satisfied them that this is in fact the case.

By the introduction of the draft-box into the penstock we are enabled to place the wheel at any convenient height within the compass of the head and fall, and still have the whole descent of water operate upon it.

While, however, the Committee acknowledge the advantages to be thus gained, (and another may be added to them, viz. facility of access at any time to the bottom of the wheel for examination or repair,) they believe that the maximum of useful effect, other things being the same, will always be found by placing the wheel as nearly as may be on the level of the water in the tail-race, so as to suffer as great a column of the water as possible to act directly by its pressure upon the wheel.

1. In regard to its useful effect, it ranks with the overshot water-wheel and turbine.

2. It possesses the peculiar advantages of the turbine, in reference to the action upon it of back-water or ice, and, like it, can be established either upon high or low falls.

3. It is simple in its construction, and of durable materials, and is for these reasons not expensive, and not liable to get out of order.

4. From its peculiar adjustment, easy access may be had to it at any time for the purpose of inspection or repair.

5. Running at high velocities, no intermediate gearing will be necessary, where such velocities are desirable.

NEW HYDRAULIC CRANE.

This curious Machine, the invention of Mr. W. G. Armstrong, has been completed, on a large scale, upon the quay of Newcastle, and is now in full and successful operation. The hydraulic parts of the apparatus are all placed beneath the surface of the ground, leaving nothing in view except the jib and pillar of the crane, and the indicators by which the movements are governed. These indicators consist of pointers, which are turned by handles, and which traverse in a circuit upon index plates, inscribed with the different actions to be performed. One of these pointers regulates the lifting and lowering of the weight; another the turning of the crane; and the third determines the amount of power to be applied. The extreme precision with which the machine can be managed by means of these indicators is a matter of general admiration, and renders the rapid movements of the crane consistent with the perfect safety even of the most fragile goods. The pressure in the street water-pipes supplies the motive power; and we trust that this first step towards rendering town water-works available for mechanical purposes, as well as for domestic

consumption, may eventually lead to the general introduction of the system which Mr. Armstrong has so perseveringly advocated. The present crane has been erected by Mr. Armstrong, under an agreement with the Corporation, according to the provisions of which a number of additional cranes of the same description will have to be erected upon the quay; and little doubt can be entertained that the plan will also be applied for lifting goods into the numerous warehouses in the lower parts of the town.—*Mechanics' Magazine*, No. 1214.

THRUST IN ARCHES.

Mr. W. H. Barlow has delivered at the Institution of Civil Engineers, a paper, "On the existence (practically) of the line of equal Horizontal Thrust in Arches, and the mode of determining by geometrical construction." The author commenced with a review of former theories on the subject by David Gregory, La Hire, Attwood, Coulomb, and Moseley. With the latter he ageeed in the principle, that the line of resistance must be contained within the thickness of the arch, at every joint, and must meet each joint within the limiting angle of fiction. The analogy between the catenary, the line of pressure of Whewell, the line of resistance of Moseley, was then pointed out, and the practicle of existence of the curve of equal horizontal thrust, together with its nature and properties, was successfully illustrated by various models. The mode of obtaining the curve by geometrical construction was next shewn, together with formulæ for obtaining the necessary thickness of abutments, &c. Numerous drawings and diagrams illustrated this part of the subject. The paper concluded with a reference to the various circumstances in which arches were placed in practice, and the modifications to which theory was consequently subject It was stated that more than thirty bridges on the Manchester and Birmingham railway had been erected, according to the principles described, with perfect success, and with considerable saving in brickwork. In the discussion which ensued, the speakers accorded in attributing great credit to the author for his accurate mathematical investigation, and the judicious application to practice.

NEW LIQUID CEMENT, AND PIGMENT TO RENDER WALLS IMPERVIOUS TO MOISTURE.

We have lately seen specimens of cement, stucco, and imitations of jasper, marble, porphyry, and agate, of considerable beauty, formed, as we are told, by a process derived from the Chinese. The leading feature of these operations is the conversion of common cheap materials into substances of a value to builders;—1st, a cement, equal in other respects to Parker's, which, as is asserted, remains uninjured by the heat of chimneys or of the sun, and impervious to frost. 2nd, an easy mode of reconverting sand or pulverised carbonate of lime into compact stone. 3rd, *imitations of* various sorts of crystallized minerals, *more diversified than scagliola*; and, 4thly, a vitreous surface, which is *applied with the brush over the* other substances in thin coats like paint.

Mr. W. Crouch, the possessor of these secrets, is an old plasterer, in early life foreman to James Wyatt, and afterwards, for ten years, in a similar capacity to Messrs. Cubitt, whose service he left to go abroad. He visited Canton, South America, and the Sandwich Islands, where he obtained a knowledge of some things which he believes to be unknown in England. After an absence of eighteen years, he returned to his own country, but up to this time has been doomed to disappointment: there are but few men ready to believe and acknowledge that an illiterate workman can be the possessor of useful knowledge; and illness and poverty have been his lot instead of fortune. An able artist, who has examined the vitreous pigment, says it appears to be a complete answer to one important query of the Royal Commission as to the success of fresco painting, and would in many ways secure architects and builders from annoyance from wet and expansion, consequent to moisture.

The cost of the vitreous pigment, or varnish, is fourpence per square yard for each coat—two or three being required.—*The Builder*, No. 174.

THE IRON SLAVE.

THIS invention, it is seriously alleged, will, at no distant period, altogether change the present system of agricultural labour, especially in warm climates; such as ploughing, sowing, reaping; also, the making of canals, roads, and tunnels. It is a frame of iron, 4 feet wide, and 20 feet long in front, with a shaft of 6 feet 6 inches long behind, with two broad wheels, and a steering wheel on the extreme end. On the front shaft are feet similar to spokes of wheels, with buffers on their extremities, which enter the ground by the revolving of the shaft. This is caused by a long lever of 20 feet, swinging backwards and forwards on a spindle, and pulling alternately two levers of three feet, in a box on two wheels, fixed to the shaft, similar to the capstan on the Great Britain steam-ship, with the difference that the motion can be reversed, or the levers so placed that they vibrate without the driving-wheel. The power to work this machine is communicated by ropes, pulling alternately on the lever; these ropes at a distance of 100 yards are wound around a double drum, and corresponding ropes run from the drum to the distance of a further 120 yards, to two cranks of a steam-engine. By this trial, a new mechanical principle is established—namely, the transition of power from a fixed point to a moving point, going in arbitrary directions at the will of one man at the steering-wheel, which was thought impossible by scientific engineers. By prolonging or shortening the communication ropes, the distance from the prime mover to the machine travelling on pulleys and rollers to diminish friction, and from the drum to the "satellite," they are held up by cars with poles if they extend to a great distance, to keep them from the ground. The machine is intended to work and move at the rate of three miles an hour. A trial has been made on a square of 11 acres, on the property of Mr. E. King, of Blackburn, Jamaica, who kindly lent to the Tropical Emi-

gration Society his steam-carriage, which, 11 years ago, was running between Hammersmith and London.—*Jamaica Times*.

VENTILATION OF MINES, WELLS, SEWERS, &c.

STRUVE's Patent Mine Ventilator seems to be a very obvious application of a very simple principle, viz., that on abstracting a portion of atmospheric air from one end of any receptacle, an equal portion will rush in at any other opening to supply its place. That such an application of such a principle, therefore, should be held entitled to protection by patent in the present day, is a melancholy proof of the indifference amongst miners to the frequent destruction of human life from want of Ventilation in Mines. In the application of Struve's invention, the upcast shaft is closed, superseding the necessity of the furnace hitherto used; it is connected with, and forms a passage for, the air from the mine, to one or two large air pumps of either single or double action. The lower part of the exterior case contains water, which, while it forms the packing in which a hollow cylindrical piston works, keeps it hermetically sealed. The apparatus may be made almost of any size, so as to take out of a mine any quantity of air, whatever may be its depth or extent. It may also be made to create a partial exhaustion of the mine, by closing the downcast shaft, which, if repeated several times, would effectually drain the goaf of a colliery.

In connection with the subject of the ventilation of, or removal of bad air from, wells and sewers, as well as mines, a recent suggestion of some value may here also be noticed. The methods hitherto in use for removing carbonic acid, or sulphuretted hydrogen gases, from situations where they have accumulated in such quantities as to become fatal to human life if taken into the lungs, are slacked lime water, or currents of air; the first slow, and the latter not always practicable. M. Faucille has lately suggested, and successfully acted upon, a plan for the complete absorption of these gases. In sinking a well at Vichy, the carbonic acid was evolved in such quantities, that the men could scarcely proceed with the work. He erected a small boiler, on the principle of the eolopile, the tube from which reached to the bottom of the well. A powerful steam blast wast kept up—which at first was opaque, from the gas uniting with the lime contained in the water, but soon became transparent—and in thirty minutes, the works could be proceeded with.—*The Builder*, No. 176.

MINE-LIFTING MACHINERY.

MR. PALMER, of Tavistock, has patented certain improvements in Machinery for Lifting in Mines, consisting of various methods of producing a continuous rotation of the winding shaft from the reciprocating movements of a beam or rack, in lieu of the band and drum usually employed. In the first improvement, a ratchet wheel is fixed on the winding shaft, *on which two* radial arms oscillate on one common *centre; from the ends of these* arms descend two rods, connecting *the arms with a beam, to which* a reciprocating movement is commu-

nicated from the engine; the outer ends of each of the arms carry a spring catch, or pall, which takes into the teeth of the ratchet wheel in opposite directions, precisely similar to the escapement of teeth on the pendulum of a clock: each of these catches or teeth thus alternately carries the wheel through a portion of a revolution, and, by a repetition of the movements, a continuous rotation of the winding shaft is produced. When a quicker motion is required, the machinery consists of a frame, to the inner sides of which two racks are bolted; two spur wheels, mounted loosely on the winding shaft, gear into the racks, and these wheels carry catches or palls, which take into the teeth of the ratchet wheel, keyed on to the shaft; a reciprocating motion is given in this instance to the rack; and by its teeth catching and escaping each rack alternately, a continuous rotation is imparted to the shaft. Another modification of this invention is by two sets of spur wheel and ratchet wheels, with their teeth set in opposite directions; the spur wheels turn toosely on a boss, and the ratchet wheels are keyed thereon: the boss is firmly connected by means of a key to the winding shaft, along which it is capable of sliding, and the whole can be thrown in or out of gear by means of a forked lever.—*Patent Journal*, No. 15.

GOLD MINES IN RUSSIA.

The produce of the gold mines in Russia is yearly increasing. In 1841, the quantity extracted from those mines was 961 lbs. (9610 kilogrammes), amounting in value to 39,000,000 fr.; in 1842, 9810 kilogrammes, value 53,200,000 fr.; in 1843, 12,950 kilogrammes, value 72,800,000 fr.; in 1844, 13,410 kilogrammes, value 75,600,000 fr.; in 1845, 13,711 kilogrammes, value 79,000,000 fr.; making in the five years a total weight of 59,490 kilogrammes, of the value of 319,600,000 fr. Up to the present time, almost all the produce of the gold mines of Russia has been exported to England; but if the quantity continue to increase progressively, or if it even no longer exceed the quantity obtained in 1845, England will cease to receive it, at least the greater part, and then it will be necessary for her to seek other markets for our gold, which it may perhaps be rather difficult to find; but let us hope that the new system of commercial policy which the Government has adopted, and particularly the reduction of the import duties, which has been the first consequence of it, will increase our consumption of foreign merchandise, in the purchase of which our gold may find an advantageous employment. However this may be, the working of the gold mines in Russia must necessarily cause, sooner or later, a great revolution in the commerce and industry, not only of Russia, but of all the points of the globe.—*Patent Journal*, No. 15.

ARTESIAN WELL AT SOUTHAMPTON.

An Artesian Well was commenced on Southampton Common in 1838, with the intention of obtaining from it a bountiful supply of water for the town. It has been carried to the depth of upwards of 1,300 feet, at an expense to the town of £12,886, and to the contractors of £11,163

above that sum; and it has since been transferred to the Commissioners of Waterworks in its unfinished state, the contractors having refused to go on with the work, unless guaranteed their expenses and fair profits by the Commissioners. The first 78 feet of soil were found to be alluvium, the succeeding 304 feet London clay, the following 97 feet plastic clay, and the succeeding chalk, in which the boring has been carried down the great depth of 821 feet, being a total of nearly 1,300 feet, and giving no indication by which a judgment can be formed as to the depth to which the chalk may yet extend; while, experience has shown that the chalk will not yield the water required, and that the great stream sought for must be obtained from under the chalk basin. The well, in its present state, will yield by pumping from 7,500 to 10,000 cubic feet of water per day; that is, however, but a fourth of the quantity it is calculated will be required for the rapidly increasing demands of the town.

During the meeting of the British Association held last autumn, at Southampton, this Well was an object of considerable interest to the *savans* assembled; a joint deputation of the Geological and Mechanical Sections visited the works at the request of the corporation to form an opinion as to the probable result of resuming the boring at the bottom of the shaft. They examined the strata and the engineer, and promised to make a special report upon the subject.

Soon after the deputation had left, Dr. Buckland, who, in July, 1844, had reported on the well, arrived, and after examining into the matter, made, according to the *Hampshire Advertiser*, (which, by the way, contains a full report of all the proceedings), the following remarks:—"The water for the supply of the well at Grenelle comes from perhaps eighty miles off, but there was no fault or dislocation between the source and the delivery. That was not the case between Southampton and the Isle of Wight, where a dislocation existed; the same might be said as regarded Winchester, where there was a break between St. Giles's and St. Catherine's Hill. They must, therefore, in order to form a judgment of the water they might expect here, and as to what height it would rise, go to Petersfield, where Dr. B. believed there was no fracture (though he was aware of the fault said to exist at Portsdown), but if it should turn out that there was, then to Wilton (near Salisbury), and make the examination there. It may be that there was plenty of water under the very spot on which they were standing, which was only finding its way out at Otterbourne and Petersfield. He was sorry, however, to mention that Mr. Gatehouse, at Chichester, had bored 1,050 feet down, of which about fifty were in the green-sand, (into which they wanted to penetrate at Southampton), having but about 97 feet of plastic clay above the chalk, while ours was 480. Mr. Gatehouse, in his note to him (Dr. Buckland) says, that having got this depth in the green sand, he at first got 78 gallons an hour; but it was now but 26 gallons an hour, and had a most intolerable odour (sulphuretted hydrogen). He, however, had not gone to the gault, and therefore he (Dr. Buckland)

would go on here at Southampton for the chance of getting water—he would go on, and if possible get to the bottom of the lower green sand. The tool or machine of M. Fauvelle promised to execute the work of boring so cheaply, that it would be most advisable to proceed with it."

Subsequently, Mr. Keele detailed to the meeting the progress of the well at Southampton, and of the strata cut through. Instead of commencing boring from the surface, a shaft was sunk to the depth of 540 feet, passing through 300 feet of London clay, before the boring was commenced. The chalk was reached at a depth of about 380 feet, and the boring through the chalk was continued till a depth of 1,260 feet was attained. The question which it was anxiously requested the Geological Section should determine is, whether by continuing the work the requisite supply of water will be obtained. The Section thus appealed to did not give a very satisfactory or encouraging answer. Mr. Hopkins alluded to the great disruptions of the strata near Southampton, as exhibited by the abrupt elevation of the chalk in the Isle of Wight, as a reason why success might be uncertain, as the water in the green sand stratum might have some vent through which to escape; at the same time, he recommended a continuance of the work. Mr. Greenough wished to shift from the geologist the responsibility of giving an answer, as the condition of the same strata is so different in different situations, as to prevent the possibility of foretelling the result with certainty. He mentioned a circumstance connected with the sinking of the first Artesian well in England, near Great Grimsby, in Lincolnshire, which, however, encouraged perseverance. The operations in that case were continued for a long time without success, and they were about to be abandoned in despair, when the spring was tapped, and the sudden influx of water put to hazard the life of the well-sinker, who was with difficulty extricated in time. The man having gone home to change his wet clothes, was on returning to the well, astonished to find a river of rushing water issuing from it; and by this means, an extensive tract of country that had been almost uninhabitable from the want of fresh water, was furnished with an abundant supply.

NEW METHOD OF BORING FOR WATER.

A VALUABLE communication has been made to the Paris Academy of Sciences, of an extraordinary improvement in the Boring of Artesian Wells, by M. Fauvelle. The process has hitherto been one of great time, and consequently great expense; for, it was necessary, after boring a few inches, to draw up the instrument to clear away the earth, stones, &c. through which it had pierced. By M. Fauvelle's process, the boring is never interrupted, for the instrument clears itself, and continues its course of perforation. This is effected by an *injection of water* through a hollow tube, so contrived as to cause a *powerful rush* under the borer, and clear away the accumulated contents by driving them to the surface. The injection is produced by a

forced pump, worked simultaneously with the instrument of perforation. Our readers must conceive at once that the labour of boring is greatly accelerated by this process; for not only is it unnecessary to disconnect the borer from time to time, in order to clear it, but the cutting point is kept continually free. The account given of the success of this new invention would be regarded as fabulous, if it were not well authenticated. We are assured that, at Perpignan, M. Fauvelle bored, in the presence of M. Arago, to a depth of 170 mètres, for an Artesian well, in the short space of fifteen days; whereas workmen have been engaged in the same town in making an Artesian well of the same depth for a period of eleven months, and their labours have not yet been completed. This is certainly one of the most valuable discoveries of the present age, for it will enable private persons to make Artesian wells at even a smaller expense than common wells, and to go to such a depth as to obtain pure water for domestic purposes.

It appears, however, that Mr. R. Beart, of Godmanchester, had already invented and patented a boring tool, similar in operation to that of M. Fauvelle's. He bored with it, in 1843, a well 65 feet deep and one in diameter, through a solid bed of clay, containing many large stones, some of which passed up the pipes of from four to five inches long, and two to three inches thick: the diameter of the pipes within being but 3½ inches, and 70 feet long; they were worked by four men, and descended from three to four feet per hour.

Another method remains to be noticed. M. Vignolles has read to the British Association a paper on Chinese boring, as practised on the Continent, and as applicable to the boring of Artesian wells and of the ventilation of mines. The ordinary method of boring is to screw together rods of one inch or more in diameter, adding the lengths (which are of six or eight feet) as the bore-hole is deepened. On the bottom of these rods, the various cutting tools are screwed; and it is the tedious operation of lifting, lowering, screwing, and unscrewing these rods, and the liability of the cutting tools to get jambed, and the twisting, bending, and breaking of the rods, which constitute nine-tenths of the labour, expense, and delay of the old mode. A method of boring is employed on various parts of the Continent, and particularly at the Saarbruck coal-mines, which is called the percussion or Chinese method. This process has been long practised in China, where they have thus bored to the depth of 1,000 feet and more. Instead of the tedious and expensive mode of boring with rods, one heavy bar of cast-iron, from six to ten feet in length, and of proportionate diameter—four to six inches—is furnished at the lower end with a cutting tool, combined with a suction-pipe, and is suspended from one end of a rope, passing over a large pulley fixed over the bore-hole. The other end of the rope is wound round a windlass, and the whole is worked like winding up and lowering down a bucket in an ordinary well; a contrivance being attached to let the weighted end down. M. Goublet-Collet has adopted this system, with the best

results, in Champagne; and the cost is only 3 fr. per foot, without any increase according to depth. The whole of the apparatus costs only 500 fr.

ARTESIAN WELLS OF LONDON.

AN important paper has been read to the Institution of Civil Engineers, describing the "Effect of the deep Wells of the Metropolis on the Supply of Water in the London Basin," by F. Braithwaite, Esq. The object was, to direct attention to the fact, that the numerous deep wells sunk in and near the metropolis are gradually draining the chalk basin; and that every additional well driven in search of water has the effect of diminishing the water level in all the wells already existing. As a proof of this fact, it was stated that, in a well at Combe's Brewery, sunk 20 years ago, the water rose at that time to within 70 feet of the surface, but that it now only rises to within 120 feet; showing a diminishing of 50 feet. From this and other instances, it was argued, that the supply of water is rapidly decreasing; and this was attributed as well to the improved under-drainage of the lands which receive the falling rain, as to the increased demand upon the springs. It was thus shown, that the deep springs are not inexhaustible,—and that obtaining water from them is attended with considerable expense and uncertainty. It was argued thence, that it is necessary to consider very carefully any attempts for obtaining a considerable supply of water from the chalk of the London Basin. A remarkable fact, also shown in one of the tables, is, that, on the 5th of April, 1832, there occurred a sudden depression, of 18 feet, of the springs, which lasted for half an hour; at the end of which time, 13 feet of the 18 were regained.

The paper contained many interesting facts as to the general amount of the supply of water from the different strata; and was illustrated by a series of plans,—the first of which was a map, on a large scale, taking St. Paul's as the centre, and describing around it a series of circles, with a radius of four miles. The external circle was divided into the 32 points of the compass; from which lines were drawn to the centre (St. Paul's). Upon these lines a series of sections was laid down,—exhibiting the various strata down to the chalk, as shown by the deep wells sunk in the districts between those lines, as far as the information could be gathered from those employed in sinking and boring them. The sections exhibit a remarkable contour of the chalk basin; and furnish a fertile subject for speculative geology, as well as very valuable information respecting the probable production of water from the various strata.

In the discussion which ensued, Dr. Buckland treated, with his usual clearness of scientific research, the difficult problem of the origin of subterraneous lakes or sheets of water, and the causes of the spontaneous ascent of the water towards the surface of the earth. He described the influence of the alternating impermeable beds of clay in retaining within the more porous strata the water received at their

out-crop; whence, it became evident, the cause of the spontaneous rising of water in the Artesian wells sunk through the impermeable London clay down to the porous chalk basin into which the water had filtered, through the fissures and veins of flints, from the extensive denuded surfaces of chalk around the London district. After treating this subject at considerable length, the Rev. Doctor alluded succinctly to the proposed speculation for supplying the metropolis with water from the River Colne; and described the labours of the Rev. Mr. Clutterbuck,—who, in papers read before the Institution, had demonstrated, by a long-continued series of measurements of the water in the chalk hills of Hertfordshire, that all the water taken from that neighbourhood would have been abstracted from the supplies of the river Colne, and would have trenched upon the water-rights of the mill-owners. He alluded, also, to the rain-gauge experiments of Mr. J. Dickenson; who during many years, had found arithmetical evidence that the quantity of summer water in the river Colne varied with the quantity of rain in the preceding winter: and regulated his contracts for paper to be manufactured in the summer and autumn by the quantity of water shown in his winter rain-gauge. These observations have been corroborated by foreign experiments.

He then treated briefly the general subject of Artesian wells,—the increased temperature of the water in the exact ratio of their depth,—the sympathy between the depression of water in the various wells throughout an extensive chalk district, proving the identity of origin of the supplies. As, therefore, the number of deep wells was constantly increasing, the extra pumping upon one of them necessarily affected all within a certain distance around it. Mr. Clutterbuck's observations confirmed this. He had further observed that the surface line of subterranean sheets of water was not horizontal, but inclined at a considerable angle, in consequence of the friction of the strata through which the water descended. Dr. Buckland concluded by drawing attention to the remarkable contour of the surface of the chalk exhibited in the sections.

HOUSE-VENTILATION.

MR. J. TOYNBEE, F.R.S., has delivered to the Royal Institute of Architects, an address upon the important subject of Ventilation, the most efficient mode of securing which was thus pointed out by the lecturer:—The example set by nature ought to be followed, and the gentle changes produced by the wind should be as much as possible imitated. The great principle is, to admit into rooms and houses a large quantity of air at a moderate temperature (60° to 65°), and that there should be an outlet for the vitiated air, the pure air to be admitted within three or four feet of the floor, and to be warmed by aid of the fire-place. The various plans for warming the fresh air were examined, and their errors were found to have been, that a small quantity was admitted through a narrow channel, and at a temperature much too high, so that its nature was deteriorated. The subject of warming abodes was also alluded to, and it was shewn that,

from the bad mode of construction of stoves and fire-places, and from improper materials being used, the smoke was not consumed. Ventilation was rendered impossible, and the greater part of the heat dispersed up the chimney.

In speaking of the means for insuring the egress of the vitiated air, it was stated that, as its temperature on escaping from the mouth is between 80 and 90 degrees, it rises to the upper part of the room, from which there should always be a means of escape. Dr. Arnott's valve had been generally used for this purpose, and thousands of people will be indebted to its use for their lives and health. If it were the custom of this country to erect statues in memory of those who, like Jenner, *saved* the lives of thousands of their fellow-men, Dr. Arnott in manifold ways had indeed earned for himself this distinction. A modification of Dr. Arnott's chimney valve, by Daw, a working man, was alluded to and displayed, which had the advantage of always remaining open, unless voluntarily closed. Various suggestions were made, shewing how easily plans of ventilation may be carried out; and Mr. Toynbee concluded his very excellent address by appealing to the architects to carry out efficient plans in the construction of buildings, by doing which they would confer unbounded good upon the public, by improving the public health.

The chairman (Mr. Tite, V.P.) dwelt at some length on the fact that there was no mystery in the science of Ventilation,—all was perfectly simple: the great point was to proportion the means of entrance and exit to the quantity of air required. As regarded decoration, there was more difficulty: the appearance of valves was offensive; and, moreover, the air, in drawing through them, left black lines around the edges.

Dr. Buckland then alluded to some houses in Edinburgh, ventilated by the late Sir John Robison, where the means of exit for the vitiated air was provided behind the cornices in every room. The reverend gentleman took occasion to comment on the injury done by the open gully-holes in our streets, and blamed the Commissioners of Sewers for not permitting them to be trapped. The necessity for permitting the escape of the bad air from the sewers was no answer. If central shafts were provided at certain intervals, with a single gas-light at the top of each, the sewers would be effectually ventilated, and the public health preserved.

At a late meeting of the Society of Arts, a communication by Mr. A. J. Green has been read, on "The Ventilation of Buildings." The paper commenced with an account of the various plans which the author had adopted for the purpose of ventilating the sick-ward and other rooms of the Sudbury Union Workhouse, and it then proceeded to point out the way in which he would propose that all large buildings about to be erected should be built. "Where a double chimney *is to be erected*, I would propose (says Mr. Green) that two air-flues *should be carried* up in the stack as near the centre as they can be *got*. *If the chimneys* be not in the centre of the side or end of the *room, the flues* should be carried so as to bring them as nearly into

that position as possible. The flues need not be more than 14 in. by 6 or 7 in., or 9 in. by 9 in.; they should be commenced from the first floor, and continued through every successive story to the top of the chimney in the same way as the flues for the smoke. One flue of the above size would be sufficient to ventilate four or five stories, if each room require it. Valves would require to be fixed in the wall or ceiling in connexion with the flue. This system of ventilation, it is considered, would be very applicable to smoking-rooms, tap-rooms, eating-houses, or any buildings where a large number of persons assemble.

MANUFACTURE AND USE OF PLATE GLASS IN ENGLAND.

THE demand for Plate Glass increases rapidly, and if it were reduced in price, as it might be, now that the trade is free from interference, would be much greater still. Mr. H. Howard has published a view of "Plate-glass making in England in 1846, contrasted with what it was in 1827." The particulars are curious, and show that large plates, which could not be made in 1827 for less than 10s. per foot superficial, can now be produced for something under 3s. per foot. The increase of sale which attended reduction of price is extraordinary. In 1827, plate glass sold for about (average) 12s. per foot, to the extent of about 5,000 feet per week; in 1836, from 8s. to 9s. per foot, about 7,000 feet per week; in 1844, 6s. to 7s. per foot, about 23,000 feet per week; in 1846, plate glass sold for from 5s. to 6s. per foot, about 45,000 feet per week, and was then nearly 50,000 feet per week, exclusive of foreign glass, which at these high prices was imported only to a very limited extent.

IMPROVEMENT OF SHEET GLASS.

MR. J. T. CHANCE and Mr. H. Badger have patented some important Improvements in the Manufacture of Glass. This invention relates—first, to an improved method of re-heating sheets, panes, plates, or other articles of glass, for the purposes of staining, painting, or enamelling. This has hitherto been effected by placing the sheets, or plates of glass, upon metallic shelves, in a muffle, and applying the heat externally; or by placing the articles upon the bed of a kind of reverberating kiln, which bed is either formed of stone or burned clay, and is well understood. By the first of these methods, it is difficult to keep the plates of glass from bending or becoming cockled; and in the latter, the direct action of the flame is injurious.

The first part of these improvements consists in applying the heat in such a manner that the advantages of both the foregoing methods may be retained without their accompanying defects. In carrying out this improvement, the patentees place the articles to be re-heated in a reverberatory, on a bed, which they prefer to be of stone, and cover them with an inverted pan of sheet iron. This pan is furnished with an aperture in the top, to which is connected a tube leading to the outside of the tube, in order to allow the escape of any vapour which may arise within the cover. The heat and flame are allowed to reverberate in tho arch or roof of the kiln, and escape by the chimney,

which should be furnished with a damper. In order to facilitate the working of this principle, the reverberatory kiln used is furnished with rails, to which suitable carriages are fitted, supporting the stone beds and covers on which the articles of glass are placed, and by this means more readily introduced and removed from the kiln, after which they are heated and cooled in the usual way. In order to save time, the beds and covers should be heated in another small kiln before being used in the reverberatory kiln.—*Builder*, No. 199.

THE PORTLAND VASE.

THE recently attempted destruction of the Portland Vase in the British Museum has had the effect of reviving public inquiry as to the formation of this beautiful work of ancient art. At a meeting of the Society of Arts in February, a paper was read On the Construction of the Vase, from Miss P. Ensell, who considers it to have been thus formed:—A jar of blue glass has been made in the usual way by the glass-blower, and its whole surface roughened. It has then been inclosed in a mould similar to those used for the formation of alabaster relievos. The jar and mould were then exposed to the action of one of the petrifying springs of Italy, and thus a clear transparent substance was deposited on the vase in such proportions as to form the figures in that beautifully white semi-transparent material which is exhibited in the Portland Vase.

Miss E. then gave various details for the practical carrying out of the operation, and suggested the propriety of undertaking a series of experiments, with a view to constructing vases of a similar description. Mr. Doubleday, the gentleman who was charged with the restoration of the Portland Vase, however, having examined its structure most minutely, proceeded to give the following account of the manner in which it had been formed:—

The base is of blue glass, and has been made in the usual manner by the glass-blower; the white figures are also of glass, and perfectly united with the base.

The blue jar having been formed, was dipped into a pot of white metal, and so the lower part of it became entirely covered with a uniform coating of white glass. The material to work upon, which is thus described, is in all respects similar to the cameo, and has been operated in the same manner. With some talent and considerable artistic skill, by a process like that of cameo-cutting or gem-engraving, the white glass has been cut away in different forms and various thicknesses by the artist. Mr. Doubleday considers that not less than three or four years of continuous labour would be required in order to produce such a work of art.

Several other gentlemen then joined in the discussion, the result of which was to establish the fact that we possess in this country both materials, mechanical means, and artists capable of executing similar works of art to the Portland Vase, and that those works, if executed, would necessarily, from the length of time and skill required in their production, be the most rare and the most costly that art can produce.

At a subsequent meeting of the Society (on Feb. 18), Mr. Doubl

day exhibited a number of specimens of ancient glass manufactures, as illustrative of the theory which he deduces as the true principle of the construction of the Vase. He imagines the blue body to have been first made, and then covered with a thin coating of semi-transparent white glass, by dipping it into that material while in a state of fusion. The vase, he supposes, was next placed in the hands of the artist, who, by a process similar to cameo-cutting or gem-engraving, produced the beautiful designs in relief which now adorn its surface. He also stated, in confirmation of his idea of the mode in which the vase was constructed, that while engaged in repairing it, he observed that there existed a coat of white glass underneath the handles, at the points at which they are united to the vase. Mr. Pellatt and Mr. Christie, who were present, and who are practically acquainted with the manufacture and working of glass, fully concurred with Mr. Doubleday in the view he had taken of its construction; but from their statements it would appear that, after all, the great merit of the work rests with the artist, as there is no difficulty at the present day in manufacturing similar materials. Mr. Doubleday stated that the bottom of the vase did not originally belong to it; and from the style in which it is executed, he should consider there to be a difference of 200 years in the date of their execution.*

FRESCO PAINTING.

Mr. R. W. Buss, in a lecture delivered at the Western Literary Institution, gives the details of the kind of frame-work which it is advisable to adopt for Fresco Pictures.

A brick wall is not so desirable as the recipient of the plaster upon which a fresco is to be executed; as Messrs. C. H. Smith and Dyce are of opinion that the London bricks are highly charged with salts, which exude every time the wall is moistened or damped, and will effloresce upon the surface of the picture—an evil which has been encountered by some artists already. To prevent this, a hydrofuge of wax, resin and oil, should be spread over the wall previously to laying the grounds for fresco, by which the damp would be intercepted. But the safer plan would be, to use battens and laths instead of the brick-work: this mode receives additional recommendation from the fact, that none of the experimental frescos painted upon such a framework, have shewn any of the defects which would result from salts or from damp.

Where great lightness, or removable frescos, are required, a frame of wood, with wire-work of either iron or copper, could be used, instead of the laths; and the Italians have a method of preparing coarse canvas, protected by laths at the back, which has a great advantage in this respect over the others. If a brick or stone wall be selected to paint upon, it will require to be thoroughly dry before

* *An elaborate Memoir has also* appeared on the History of the Vase: it is *entitled, "A New Elucidation* of the Subjects on the celebrated Portland *Vase, formerly called the* Barberini, and the Sarcophagus in which it was *found." By Thomas Windus,* F.S.A. (Nichols). Mr. Windus has likewise *reprinted, with annotations,* Wedgewood's Memoir on the Vase.

laying the rough coat of plaster. This first layer is composed of river sand and lime, in the proportions of two parts of sand to one of lime, or three parts of sand to one of lime. A wall thus prepared, the old authors and German artists maintain, should remain in this state, even for a space of two or three years, in order to harden and to ameliorate the causticity of the lime; but on this point our practical men in this country differ. They state, that if the wall be not in a *bad state*, the mortar will dry in the course of a week or two, and after that period the lime undergoes no other change. Also, with respect to the lime, that it need not be so old as required by Professor Cornelius, who, it is stated, kept the lime eight years before he commenced his works in the Ludwig Kirche.

Our plasterers are of opinion, that a few months are amply sufficient to extract the injurious tendencies of lime. The lecturer stated that he had used lime of various degrees of strength and age, and that the lime he had been furnished with by an experienced plasterer; it had been slacked only a few months, but proved quite satisfactory, as it neither blistered, became patchy, nor changed the colours. Upon the whole, therefore, it may be considered, that a greater stress has been laid on the necessity of keeping the lime a very long time, than there is any real occasion for; and it is highly probable that many of the defects, failures, and mischances attending fresco works, are more attributable to the bad state of the walls than the excess of causticity in the lime.

The second coat should be composed of more lime, two parts or less of sand to one of lime; and when this has set, the *intonaco* may be laid. This is the third layer of plaster, upon which the picture is painted. Some artists substitute marble-dust for the sand, but it does not work so agreeably as the sand, and it is to some eyes disagreeably white. It appears to have been the practice of the early Italian masters to have drawn with charcoal the design upon the dry wall, then to wash in the outlines with a brush and some ochre, and over these markings to have laid a very thin intonaco, so as to allow them to see the drawing through it, and on the portion of wet plaster to complete the painting.

The colours employed should be almost entirely of mineral origin, carefully selected, well ground, and kept in small pots with covers to them. Ultramarine is a difficult colour to manage, as it is apt to fall off the picture in the form of powder; to remedy this, the Italians usually painted this part in tempera over a ground of *black* or *red*, or a mixture of both. Lake is not available in fresco, and it is supposed that the boasted colour called hæmatite, and by several other names, was in reality no nearer to the quality of lake than Indian red, to judge also from some English specimens which have been procured. What-may be the age of the time, those colours which do not quickly change *upon a trial slab* may be used.

Having a well-dried rough coat of plaster upon a frame work with *laths*, clean washed river sand, and lime a few months old; distilled or *rain water*, brushes rather long in the hair, and colours of mineral ori-*gin*, with a few metallic preparations, all of which have been we

tested; the grounds may be laid, and the picture painted with little or no fear as to the results. In the application of the colours, it is important to remember that no depth beyond the dry state of the colour is available in pure fresco; that a tint compounded of lime dries gradually lighter by three or four degrees, and that a wash, *i. e.* colour diluted with water without any lime, dries a little lighter, while the ground under it dries three or four degrees lighter; the consequence of which is, that the tint when dry is annoyingly dark, and quite out of keeping with the ground.

Of the cartoon sketches for colour, effect, &c., the case is much the same as that required for any work upon which the artist is willing to trust his reputation; every point must be decided before the picture be commenced, avoiding dark subjects and those requiring transparency and depth, which belong more to oil painting than fresco.—*Abridged from the Builder*, No. 195.

PROPERTIES OF STEAM.

A NEW and very extensive series of experiments has been lately made in France, by authority of the Minister of Public Works, under the superintendence of M. Regnault, to ascertain the Elastic Powers of Steam at different temperatures and pressures. The subject, as our readers are aware, has already occupied the attention of many distinguished men, among whom the most deserving of notice are Gay-Lussac, Dulong, and Arago, in France; and Watt, Dalton, Robinson, and Ure, in our own country.

The questions to be determined by M. Regnault were—1. The law which unites the temperatures and elastic powers of aqueous vapour at saturation. 2. The quantity of heat absorbed by a kilogramme of water at 0 degree, to be converted into steam for saturation at different degrees of pressure. 3. The quantity of heat absorbed by the same quantity of water in order to raise the temperature to the point in which it assumes the state of vapour under different pressures. 4. The specific heat of aqueous vapour at different stages of density and at different degrees of temperature. And 5. The co-efficients of dilatation of aqueous vapour in different stages of density. M. Regnault repeated the results of his researches to the Paris Academy of Sciences. In these results he agrees mostly with MM. Dulong and Arago, particularly as regards high rates of pressure. Watt supposed the total quantity of heat necessary for the transformation of a kilogramme of water into the state of steam to be under a constant pressure. The number admitted was 650. This law, though not exemplified by any precise experiment, had been till very lately regarded as positive, and so adopted in theory and practice. M. Regnault, however, has ascertained that this number increases constantly from 622, under the pressure of one-fifth of an atmosphere, up to 670 under fifteen atmospheres. At the ordinary pressure, the average of 38 experiments gives *636·37. As to the* calorific capacity of water, it is 1000 *between 0 and 30 degrees; 1005* between 30 and 120; 1013 between *120 and 190.—Mechanics' Magazine*, No. 1169.

IMPROVED OSCILLATING STEAM-ENGINE.

At the anniversary meeting of the Royal Cornwall Polytechnic Society, there was exhibited a Model of this improvement by Mr. J. B. Bone, of Budock. The advantage which this engine exhibits over the common oscillating engine is the introduction of a circular valve or cock instead of the ordinary slide valve, thereby dispensing with the eccentric guides, &c., which render the engine much less complicated and more easily managed, as one lever is all that is required to ease, stop, or reverse the engine. In oscillating engines with slide valves, it is necessary to have a large weight on the opposite side of the cylinder, in order to balance the nozzle, which is in some engines several hundredweights of iron. By using the valve or cock as here introduced, the slide, nozzle, weights, &c. are all dispensed with, which will prove a great advantage, particularly in small river boats, or where light machinery is required.

MACHINE FOR COVERING WIRE.

At the above Institution was also exhibited an improved Machine for Covering Wire with cotton or silk for electro-magnetic purposes, or for making bonnet-wire. It is adapted to cover wire from one-quarter of an inch to one-five-hundredth of an inch diameter, and the whole can be worked by a lad 18 years of age with scarcely a possibility of doing wrong. It will cover wire at the rate of from one to two miles in twelve hours, and is so adapted that it can be made to cover double, the outer layer being transversely laid on to the inner one. The wire is covered with the greatest regularity, the machine having six hundred different motions, all of which bear a known relation to each other, so that the velocity with which the wire passes, in proportion to the rate with which it is covered, can be adjusted with the greatest nicety; and the requisite degree of tension upon the cotton being given by delicately-adjusted springs, prevents the liability of the cotton to break by the quick motion. The working of this very ingenious machine excited the admiration of the company.

IMPROVED MINE QUADRANT.

This instrument was exhibited to the Royal Cornwall Polytechnic Society, by Mr. Wilton, of St. Day, who remarked, that the practical miner had always been subject to considerable inconvenience in using any of the common Quadrants attached to the miner's dial for finding the angle of elevation or depression so often necessary in under-ground operations. To use the instrument exhibited, it is only necessary to stretch the measuring chain through the shaft, winze, sink, or other part of the mine to be surveyed, and to hang on the quadrant to a link of the chain, when the plumb-line will cut the respective divisions in each series required. If any doubt exist of the correctness of the quadrations, the instrument may be inverted on the chain, when the plumb-line will cut the divisions on the opposite side of the limb, and a mean between the two results will give the truth. The instrument is made to snap to a link of the chain by the simple

contrivance of a spring, &c. The inventor observed that this instrument was not offered as a substitute for the above elaborate quadrant in surveying situations easily accessible, but was presented to the practical miner because it supplied a desideratum which all other instruments want.

ECONOMY OF MUNDIC.

At the late Anniversary of the Royal Cornwall Polytechnic Society, Mr. Oxland illustrated a peculiar process by which the almost useless ores of Mundic raised in the above county, are turned to good account.

The sulphate of soda thus produced by treatment in a black ash furnace is converted into an alkali, which is extensively employed by soap and glass manufacturers. The mixture of sulphate of soda and per-oxide of iron has also been found to be valuable as manure. The per-oxide of iron alone has been employed as crocus for polishing plate glass, and associated with fatty matter it produces an admirable lubricating material for machinery. By an extended application of the principles in these processes, namely, the production of sulphuric acid by the oxygen of air alone, without any assistance from that obtained by decomposition of nitrate of soda, chlorine has been produced for the manufacture of chloride of lime, by applying the oxygen of the air to the decomposition of hydrochloric acid, instead of (as by the usual process) obtaining the oxygen by a decomposition of the black oxide of manganese. The advantage of this process consists not only in obtaining the oxygen without cost, but also in securing double the quantity of chlorine from a given quantity of hydro-chloric acid, as compared with old processes. Since the introduction of this process, chlorine has also been obtained, by an invention of Mr. Longmaid, by causing the oxygen of the atmosphere to act on the chloride of iron, volatilising as in the process for producing sulphate of soda, oxidising the iron, and setting the chlorine free. These processes are likely to be advantageous to the Cornish mines, as affording the means of rendering sulphur ores of some value that were hitherto valueless; and also, by reducing the cost of producing alkali, it is probable that this substance may eventually be extensively employed in smelting operations. To the public generally these operations will be advantageous, by producing at less cost, soap, soda, and glass in its various forms. The processes are now being put into most extensive employment at St. Helen's, near Liverpool.

ON THE MEASURE OF IMPACT BY PRESSURE OR WEIGHT.

BY PROFESSOR L. GORDON.

The object of this note is to point out that some recent attempts to measure the force of Impact absolutely by the registered indication of a spring dynamometer will give only comparative results, varying for each particular spring used.

Supposing the spring's elasticity to be such that equal pressure *produces equal elongations, it* is demonstrated that its registration *under the influence of a weight* suddenly brought upon the dynamo-

meter, and its acquired velocity, will be double the elongation due to the weight, supposing all acceleration of motion carefully prevented.

If the weight be let fall from a certain height, elongating the spring by impact, it is shewn that registered elongation or maximum elongation will exceed that due to the weight W by a quantity equal to a mean proportional between this elongation, and the same increased by double the height fallen through. This latter mean is the direct measure of the influence of the inertia of W, or its momentum, the mechanical effect accumulated in the dynamometer spring.—*Trans. Phil. Soc. Glasgow.*

RUTHVEN'S MODE OF PROPULSION.

MR. RUTHVEN'S Model Steam-boat at the Rock Ferry has been introduced to the notice of the scientific and others interested in steam navigation, by Mr. M'Quie, of Liverpool. The principle or law which has been made subservient as a propelling power by Messrs. Ruthven, the patentees, has relation to all fluid bodies. It has been ascertained that the discharge of a fluid through an aperture or pipe produces an internal pressure in an opposite direction to the discharge, and in proportion to the area and pressure employed.

In Messrs. Ruthven's model, this principle has been very successfully applied. Directly under the engine, and below the water-line, is a large circular iron case, into which a supply of water (received through a small aperture at the bow) is conveyed by means of a flat pipe laid on the kelson. The power of the engine is solely employed to revolve a fan-wheel inside this iron case, thus communicating a rotary motion to the water, which then passes towards the periphery of the case through corresponding apertures and pipes, communicating with two nozzles on the outside of the vessel (one on each side), where it is discharged above the water-line. These nozzles or bent pipes are so arranged that they may be turned by seamen on deck, so as to discharge the water either towards the bow or stern. When the nozzles are pointed towards the stern, the vessel is propelled forward; when towards the bow, she goes astern; when pointed downwards, she remains stationary. It is unnecessary to add, the engine requires not to be reversed or stopped during these operations.

Now the advantages accruing from these arrangements are obvious and manifold. In the first place, the hull of the vessel remains perfect, and her sailing properties not at all interfered with. A greater speed is attained with the same power than by the paddle-wheel or screw. There is no reaction upon the engine; therefore no vibratory motion is communicated to the vessel. The engine, on this account, may be made much lighter, as it is only subject to an uniform and regular strain. The vessel is rendered quite independent of her helm, for if one nozzle be pointed to the stern, and the other towards the bow, she will turn round as on a pivot. Should she spring a leak, the supply of water could be instantly cut off from the ordinary conduit and taken from the hold. Many other advantages appear obvious in this simple application and arrangement of a great principle, among which may be enumerated that "as it is never requisite

to reverse or stop the engine in cases of danger, emergency, or detention, so the tendency to explosion is avoided. Sails may also be used to any extent, either with or without the steam power."

At Leith, the patentees have a steam-boat about 40 feet long propelled by this power at about eight miles per hour.—*Liverpool Times.*

IMPROVED ANCHOR.

LIEUT. RODGER, R.N. of Chelsea, has patented an improved construction of the stocks, shanks, arms, and palms of Anchors, in such a manner that they will, with the same weight of metal, be much stronger in the direction in which the strain comes on them, and have greater holding power than any other which have hitherto been used. The form, as the patentee describes it, is based on the princple of the wedge, which is a cross section of the stem or shank, and being of a rectangular form, is better calculated to resist the strain to which that particular part is subjected, than an anchor of the usual form. The stem is reduced at the end next the stock, where the principal strain being torsion or twisting, it is better suited to resist than any other. The arm of the anchor is of a wedge shape, the outer circumference of the arc being broader than the inner, and thus disposing the metal so as to obtain the greatest amount of strength, and, at the same time, having a greater holding power by the pressure of the soil on the sides of the arms. The palms are made with the bevelled sides in front instead of being at the back, as usual; the effect of this shape is also to produce a greater holding power by presenting the bevelled sides to the soil instead of the flat surface, as has hitherto been the case; and in dragging the anchor he has found, from actual experiment, that the soil fills up, behind the palm, and prevents the water from entering the rut, thereby receiving a more beneficial effect from the superincumbent weight of water from its tendency to consolidate the ground. In applying one part of this invention to anchors already made, a piece of iron is welded on to the front of the arm, to form the palm, the parts projecting beyond the arm being bent back, and forming the bevelled surfaces, which will have a similar effect to that already described when the palms are forged out of the solid.

STEAM-ENGINE IMPROVEMENTS.

M. PROSPER PIMENT has brought before the public an improvement in the Condensation of Steam after it has done its duty in the cylinder. The steam on leaving the cylinder passes into tubes surrounded with the water intended for continually supplying the boiler; it is thus quickly condensed, giving out its heat to the surrounding medium. The construction is simple, inexpensive, may be easily supplied, and he claims for it the following advantages:—A continual supply of water already at a temperature of 95°; the water perfectly distilled and purified before entering the boiler, and therefore preventing incrustation; *greater regularity* in working the steam-engine, and a *great saving in fuel.* This invention can be no longer considered an

experiment, as it is in operation in several of the rivers in France.—*Patent Journal*, No. 11.

NEW STEAM-ENGINE.—MAGNETIC ENGINE.

M. A. Seguier has read to the Paris Academy of Sciences, a notice of a New Steam-engine, the invention of Messrs. Isoard and Mercier. After describing the construction of this engine, M. Seguier says:—"It differs from all that has hitherto been invented, not only in its construction, but also by the special manner in which the steam is employed. Instead of being conveyed from the generator to the motive apparatus, and undergoing on the way, or at the moment when its action is required, all the losses due to the diminution of volume by the causes of the cooling process, the steam is maintained at a very elevated temperature in the generating tube, and the relations of the heated surfaces and of hot water injected are calculated in such a way that the heat does not escape by the orifice until it has acquired an increase of temperature which permits it to act at once as steam and as dilated gas."

There has also been read to the Society of Arts, a communication by Dr. Paltrineri, "on a New Steam Engine, Magnetic Engine, and other machines in which the moving power is applied simultaneously, by Action and Reaction, to the work to be performed; being illustrations of a system for obtaining all motive powers and maximum of effect." Dr. Paltrineri conceives that the maximum of effect is to be obtained by applying simultaneously the action and reaction of every motive power with equal velocities to the production of the useful effect. He exhibited a double turbine, in which the water, steam, or other moving fluid, is applied by means of two concentric wheels, through which the fluid passes successively; and by this means he showed that a residual effect, which is lost on the ordinary single wheel, would be converted to use by the double. He showed the same results in the case of his new magnetic engine, and he illustrated the fact by a machine in which the constant force of a spring is applied to raise a weight, first by having one bend released and the other fixed, and next by releasing both bends simultaneously, and in which latter case the maximum of effect is utilized. The machines were simple in their construction.—*Athenæum*, No. 961.

INCRUSTATION IN BOILERS.

Mr. W. West has read to the Institution of Civil Engineers a paper "On Water for Locomotive Engines, and its Chemical Analysis," in which he recommended, as a means of precaution against incrustation, the selection of waters which by analysis were found to contain only soluble salts; or, in situations where bad water could alone be obtained, that the boiler should be frequently "blown through," in order to get rid of the dense saturated part of the water before the crust had time to be deposited. The introduction of substances, such as potatoes, leather shavings, &c., into the boiler, in order to prevent incrustation by enveloping the earthy particles in a slimy coating, is inapplicable to locomotives, because of their tendency to induce priming.

The paper noticed slightly the various patents for preventing adhesion in boilers, and in the appendix gave the analysis of many kinds of water which had been submitted to the author professionally for his opinion. In the discussion which ensued, Mr. Gooch demonstrated the importance of the subject to railway and steam-boat companies, and stated that his attention had been called to a process invented by Dr. Ritterbant, for preventing Incrustation in Boilers. That process consisted simply in the addition of a small quantity of muriate of ammonia to the water in the boiler. It had been found, that this remedy not only effected the object proposed, but that it disintegrated and removed the incrustation already formed. In all the locomotives in which it had been used, the steam was much more readily generated, so that the blast pipes of several engines had been enlarged without diminishing this facility. There was, therefore, no doubt, of a great saving of fuel being effected by the process, the expense of which was stated to be about threepence per hundred miles run of a locomotive engine.

In sea-going steamers, the success of the experiment had not been less remarkable. In all these cases the water had been tested by practical chemists, without the slightest trace of iron or copper being detected, shewing that there was no injurious effect upon the metal of the boiler, &c.

Dr. Ritterbant, in a concise and lucid manner, stated the results of his investigations: it appeared that carbonate of lime was the only substance which formed a solid incrustation; the other substances being merely mixed with, and cemented by, the carbonate; and that the muriate of ammonia acted as a perfect solvent of the carbonate of lime, converting it into the soluble muriate, without acting upon the boiler. He gave a practical demonstration of the action of the muriate of ammonia on calcareous water to the satisfaction of the Institution, who expressed themselves in terms of approbation of the great practical utility of the invention.

NEW BLOWING-OFF APPARATUS FOR TUBULAR BOILERS.

The *Artizan* states that a blowing-off apparatus has been applied to the boilers of the steamer 'Tagus,' by Mr. Lamb, engineer of the Peninsular and Oriental Steam Company, which is found to operate satisfactorily. It consists of a pipe leading from near the top of the water in the boiler, and to the mouth of the pipe a float and valve are attached; so that when the water level falls below the mouth of the pipe, the valve is closed and the steam is unable to escape. The advantage of the arrangement lies in causing the water to be blown off from the surface of the water, which it cannot be doubted is the situation from which a blow-off pipe should proceed. The particles of impalpable matter which, by their subsidence on the flues, are converted into scale, are carried by the *rising* steam to the surface of the water; and *if they can there be caught* and discharged from the boiler, the *formation of scale will be to a great* extent prevented. This it appears *is successfully done by Mr. Lamb's* apparatus.

NEW PROJECTILE.

MR. M'CARTEY, who is connected with the navy-yard at Brooklyn, (U. S.) has invented a new species of Artillery, which will discharge thirty balls in a minute, or one every two seconds, for hours together, in succession; and this by mechanical power alone, without gunpowder, chemical substance, or any other preparation. It is effected by merely putting the balls into a hopper, and letting the ordnance throw them out with immense momentum at the rate of one every two seconds. On one occasion, Mr. M'Cartey exhibited the operation of this in the navy-yard. From twelve to twenty pieces of solid timber were united together, forming one compact body. Against this piece of wooden breastwork Mr. M'Cartey opened the battery of his piece of ordnance, and in less than ten minutes the whole solid breastwork was utterly demolished and shivered to splinters by the powerful and rapid succession of discharges upon it. The simplicity of this invention is one of its most singular features. The principle is simply a modification of the sling applied to machinery, in connection with a tube or gun, throwing out a discharge of balls. The machine is so constructed that on putting in at one end the balls to be discharged, a rotary motion is produced by means of a crank, and, by a few rapid revolutions, each ball receives a force and momentum equal to that communicated by any quantity of gunpowder. When this has been done, a slide starts and allows each ball to escape in succession from a chamber into a tube, whence they are thrown to almost any distance and with unerring aim. For this invention a patent has been taken out at Washington.—*New York Herald.*

HALE'S WAR ROCKET.

SOME interesting experiments have been made with this Rocket at Woolwich. It differs principally from the common rocket in having no stick. Sixteen of Mr. Hale's 6-pounder rockets were fired at various elevations from a small portable apparatus, which allows of their being fired from a small boat quite as effectively and convenienly as from the deck of a line-of-battle ship. The first four fired were projected in a horizontal direction with the greatest precision, and struck the water at distances varying from 500 to 700 yards, after which they rose at 700 or 800 yards further, *en ricochet*. The other twelve were fired at a greater elevation, and before striking the water *en ricochet* went a distance of from 2,000 to 3,000 yards, their direction varying but very slightly. After the firing of Mr. Hale's rockets, six of the "service" 12-pounder Congreves were fired as a comparative experiment, at the same elevation as Mr. Hale's, but from a tube 15 feet long, which ranged about the same distance as Mr. Hale's, and also pursued a very good direction. The 12-pounder rockets now in use in the navy and army have sticks attached to them *nine feet long*, and the length of the stick increases in proportion to *the weight of* the rocket; thus a vast amount of space, very valuable *in stowage, is* wasted; whereas Mr. Hale's invention requires no such *expensive* and inconvenient auxiliaries, and is, of course, more econo-

mical, less cumbrous, and infinitely less liable to become unserviceable from damage.—*Mechanics' Magazine*, No. 1182.

WHITE'S PATENT FIRE-ENGINE.

INSTEAD of making use of two large pumps, such as are in general use, and which require from twenty-five to thirty-five men to work them, and in some large ones forty and upwards, Mr. White's Patent engine consists of an indefinite number of small pumps of very great power, from twelve to twenty-four if needful. Each pump is a perfect fire-engine in itself; but the whole are so arranged as to discharge their contents or water into a common receiver or air-vessel, and from thence to the fire in the usual way. By this method each man can exert a power upon his respective pump equal to 70lbs. upon the square inch, while by the engines in common use it requires the united power of thirty men to produce an equal pressure.

THE DIVING-BELL.

A PAPER has been read to the Institution of Civil Engineers by Mr. W. Vanderkeite, describing a very useful arrangement of machinery for working the Diving-bell used in setting the masonry, at a depth of about eight feet below the level of the extraordinary spring tides, in the extension of the pier at Kilrush in the river Shannon, under the direction of Mr. T. Rhodes, the chief engineer of the Shannon Commissioners. Upon a series of piles and longitudinal timbers a railroad was laid, upon which two travelling platforms were constructed; with winches, &c. One of them brought the stone nearly over its intended position, and lowered it into the sea; the other then brought the diving-bell over it, and by means of a chain and purchase, the stone was lifted and placed properly in its place by the men in the bell. This work was continued through all seasons, and with the utmost regularity; and the work so constructed was as solid as if built on dry land.

NOISELESS CARRIAGE-WHEELS.

MR. R. W. THOMSON, of the Adelphi, has patented an Improvement in Carriage-Wheels, which is also applicable to other rolling bodies. The invention consists in the application of an elastic substance, or surrounding belt, to the rim or felloe of wheels for carriages and other rolling bodies, for the purpose of producing a more regular motion to the vehicle, and avoiding the jolting and friction incident to the present mode of conveyance.

The inventor prefers using an air-belt of four or five inches in diameter, formed of air and waterproof substances, such as several thicknesses of canvas, saturated and covered on both sides by a solution of India-rubber, or gutta percha. The specification contains several views of wheels with the application thereto. The wheel is constructed with a much broader felloe and tire than usual, to which felloe, by means of bolts, is secured a strong leather case to contain the belt. This belt (which is an air-belt) is then laid round the tire, and secured by lopping or rivetting the unjoined edges of the leather,

which is placed on in segments. A pipe is inserted through the [illegible] of the wheel for the purpose of inflating the air-belt; this pipe is fitted with an air-tight cap.

Instead of air (which the inventor prefers, as being more elastic), various solid bodies and flexible substances may be used, such as metallic springs; or the belt may be distended by pieces of sulphurised India-rubber, horse-hair, or sponge.—*Patent Journal*, No. 4.

SCOVILL'S HORSE-POWER DRILL.

THIS is a very ingeniously contrived machine for drilling into rocks. The drill, placed between a gallows frame, is raised by a crank motion, similar to the pitman of a saw-mill, and carried with rapidity up the ways or slides to a point where it becomes detached from the nippers, and falls by its own specific gravity, changing its position the sixteenth part of an inch at every fall. When propelled by horse-power, it is estimated to do the work of twenty five men, and leaves the rock in better shape for removal than the ordinary process of hand-drilling. These machines have been extensively used upon the summit division of the Illinois and Michigan Canal, where they have been satisfactorily tested; they possess, in the opinion of the several engineers on that division, the merit of being cheap, durable, light, and very efficient, being computed capable of drilling in solid rock a 40 feet hole, five inches in diameter, in one day.—*Buffalo Patriot.*

BOGARDUS'S UNIVERSAL ECCENTRIC MILL FOR HULLING, CUTTING, AND GRINDING.

(From the Journal of the Franklin Institute.)

WE deem this one of the most useful and important inventions of the time. Mr. Bogardus is an American citizen, a resident of the city of New York, and well known, from the number and variety of his inventions, as one of the most ingenious of our countrymen. The American Institute awarded to him their highest premium—a gold medal—for an article exhibited at the fair; and the Lords of the Treasury in England gave him their premium of £200 for the best form of wafer-stamp, which was offered immediately after the adoption of the present postage system of Rowland Hill. In consideration of the great merit of the invention now under consideration, Congress, at its present session, extended the patent for it for fourteen years by special act.

In Mr. Bogardus's mill, the principle is entirely new: both plates revolve in the same direction (with nearly equal speed) on centres, which are apart from each other one inch, more or less: the centre of the one, or axis thereto affixed, resting on, or revolving upon, a stationary point; whilst the prime mover, by means of a belt or gearing, communicates motion to the other plate. The circles which are cut *in the plates* act like revolving shears, cutting every way, which, when *in operation*, causes a peculiar cutting, wrenching, or twisting and *sliding* motion, admirably adapted for every species of grinding. *From the* position of the two centres, it is named the Eccentric Mill.

The following are some of its advantages:—

1. The peculiar motion of the plates will of itself discharge the ground substance, so that many substances can be ground thereby which would altogether choke other mills.

2. In other mills a given point in one of the plates continually describes the same circle on the other; but in this mill it traverses on the other plate at an infinite variety of angles, every point within two concentric circles apart from each other, twice the distance of the centres of the plates, thereby rendering the wear and tear of the plates uniform, and preserving the grinding action of every point.

3. In other mills the grinding power of each point increases with its distance from the centre; but in this mill every point from the centre to the circumference has the same grinding power. A considerably smaller mill will, therefore, effect a given purpose, and the eccentric mill is therefore more portable than other mills.

4. The ever-changing action of the mill, and the quick discharge of the substance ground, prevent it from becoming heated, so that the eccentric mill may be profitably employed in grinding substances which, in other mills, would be either spoiled or deteriorated in quality, or, by their melting, be impossible to be ground. If other mills were driven with that speed which can be safely applied to the eccentric mill, they would be made red hot in a few minutes.

Bogardus's mills have been successfully introduced for the following purposes:—

Hulling rice, coffee, and olives. Grinding grain of all kinds; paints of all kinds in water or in oil; iron, zinc, copper, and gold ores, plumbago and manganese, bones for manure, and bones for refining sugar, flint and quartz, charcoal, plaster, putty, printers' inks, drugs and dye stuffs, snuffs, mustard, coffee, spices, loaf sugar, starch, gums, resins, asphaltum, India-rubber, flax seed, and oil-cake, &c.—Quoted in the *Mechanics' Magazine*, No. 1198; which see for engravings of this important invention.

WORTHINGTON'S TIDAL POWER.

THE storing of Tidal Power as a motive power for machinery has often been suggested, but there has always been the difficulty to overcome of getting rid of the back flood, which would stop the revolving wheel. Mr. Worthington, of Manchester, has discovered the means of obviating this difficulty, of which he has constructed a working model, the water of a miniature sea flowing into two half-tide reservoirs, and from them through the wheel races, so as to turn an undershot wheel, which is supposed to give the motive power. At high water, the sea will fill those through sluices; at low water, the sluice-gates, or paddles, are closed, and the water retained in the reservoirs in sufficient quantity to serve the wheel till the tide returns to give a fresh supply. Whenever, from high tides or other causes, the water rises higher than the centre of the water wheel, the wheel would become what is termed "back-flooded." To avoid this, a third reservoir is constructed at a lower level below that of the low water mark; and into this the waste water from the wheel runs at flood tide, and is let out at low water, to flow back to the river or sea,

through a sluice, which must be closed again when the reservoir is empty. Mr. Worthington suggests that, at sea-ports, such as Liverpool and Hull, long river or sea walls be built, so as to impound the tidal water behind them in reservoirs; and that the corporate bodies of these towns might let the power for mill purposes. Perhaps one of the largest water wheels in the kingdom is at Compstall bridge; and it is there found that a reservoir of five acres, holding seven feet of water, will rotate this wheel during eight hours with a motive power equal to that of 300 horses.—*Manchester Guardian.*

WASTE OF WATER POWER IN IRELAND.

In Lancashire, every available rivulet is caught hold of. The little current which passes by Bolton and Manchester, Dr. Kane somewhat quaintly styles "the hardest worked stream probably in the world;" in a fall of 900 feet, not less than 800 are appropriated to the use of mills. Now, the Shannon (whose total basin amounts to the prodigious area of 4,544 square miles) falls 147 feet from the Lough Allen to Limerick, the last fifteen miles from Killaloe, presenting a difference of level of not less than 97 feet! The total continuous power above Killaloe, calculated from the level of basin, is 4,717 horses' power, that from Killaloe to Limerick something above 350 horses' power for every foot of fall, making, for 97 feet, the immense force of 33,950 horses' power; these added together giving a force in interrupted action, day and night, at every moment of the year, of 38,667 horses' power! Yet, with the exception of a few corn mills along the trajet of the river, this invaluable force is allowed, day after day, to go to waste.—*Dublin University Magazine.*

WATER RAISED BY WATER.

In the West India Islands, there is an excellent arrangement for Water. Large upright tanks, made of plates of cast iron, stand up against the tall buildings, like immense octagonal sentry-boxes, 12 or 20 feet high, which are supplied by rain water from the roofs. The pressure of the water sends a powerful stream through the cock below when the key is applied, and the water is useful for household purposes (after filtering) for watering the streets or extinguishing fires.—Sir J. E. Alexander, in the *United Service Journal.*

WORKS IN DOVER HARBOUR.

Among the more striking specimens of mechanical skill in these works, is a new entrance to the "pent," or inner harbour. This opens from the new excavations, and is nearly double the width of the old northern gates, measuring nearly sixty feet wide, and having three feet more water, thus admitting vessels of a far greater burden than heretofore. It is provided with lock gates formed of massive cast-iron ribs, with planks on each side to render them buoyant. Across this entrance is thrown a swing bridge, having a span of sixty feet, and a roadway sixteen feet wide. It has been cast under the direction of Messrs. Hunter and English, of Bow Creek.

BRITISH IRON MANUFACTURE.

To shew how cheaply iron is obtained, and how the mechanical skill and labour expended upon it totally overshadow the original price, a late number of the *British Quarterly Review* gives the following curious and instructive calculation :—

Bar-iron worth £1. sterling, is worth, when worked into—

Horse shoes	£2	10
Knives (table)	36	0
Needles	71	0
Pen-knife blades	657	0
Polished buttons and buckles	897	0
Balance springs of watches	50,000	0

Cast-iron worth £1. sterling, is worth, when converted into—

Ordinary machinery	£4	0
Larger ornamental work	45	0
Buckles and Berlin work	600	0
Neck chains, &c.	1,386	0
Shirt-buttons	5,896	0

Thirty-one pounds of Shropshire iron have been made into wire upwards of 111 miles in length; and so fine was the fabric, that a part of it was humorously converted, in lieu of the horsehair, into a barrister's wig! The process followed to effect this extraordinary tenuity consists of heating the iron and passing it through rollers of eight inches diameter, going at the rate of 400 revolutions per minute, down to No. 4 on the wire gauge. It is afterwards drawn cold, at Birmingham or elsewhere, down to the extent of 38 on the same gauge, and so completed to the surprising length of 111 miles.

Of the quantity of iron manufactured in Great Britain, South Wales produces 279½ thousand tons; Staffordshire, 219¼; Shropshire, 81¼; Scotland, 37¾; Yorkshire, 33; Derbyshire, 22¼; and North Wales, 25.

GODSON'S SMOKE-CONSUMING FURNACE.

Mr. W. Spence has read to the Society of Arts, a paper "On Mr. Godson's patent Furnace for consuming smoke and economising fuel." The general features of the furnace, and the parts of which it is composed, may be thus described :—A box, with a moveable bottom or feed-plate for the fuel, and fitting its internal surface, is substituted for the ordinary bars in the middle of the furnace, and is capable of being raised or lowered within the box or chamber, and which is made to occupy a position in the ash-pit below the furnace. The fuel is fed on the plate while in its lowered position, and when raised it is introduced into the centre of the fire; by which means the smoke evolved from the fresh fuel is consumed. The construction was described, and a model and diagrams were exhibited.

NEW LIGHT.

M. Gaudin has presented to the Academy of Sciences, at Paris, an account *of a New Light which* he proposes to have on board ships, so *as to prevent accidents at sea.* The apparatus consists of a reservoir *of oxygen, from which the gas* flows under a pressure of mercury, and *enters a flame produced* by ether or spirits of wine through a small

aperture at the axis of the wick, and the light thus oxygenated is thrown upon a piece of magnesia fastened to a thread of platina. The lamp in which these are placed has a reflector, and the whole is enclosed, with apertures for air, in such a way as to be safe from external injury. M. Gaudin is of opinion that this light may be applied with great advantage to railroad locomotives, as well as vessels at sea; and the expense does not appear to be at all in proportion to the important service that it would render.

NEW CEMENT.

MR. KEATING, of North Mews, Fitzroy Square, has patented certain Improvements in the Manufacture of Cement; relating to a method of combining gypsum or other calcareous substances with borax, for the purpose of forming a cement.

For this purpose, a solution of borax is made by mixing five pounds of borax in six gallons of water, and in another six gallons of water, dissolving five pounds of crude tartar; and when both are dissolved, mixing the two solutions together. The gypsum, (previously deprived of its water of crystallisation by heat,) is then put in the solution (in lumps), and allowed to remain in the solution till it has absorbed as much as it will take up. It is then taken out, and heated red hot in a proper oven; next allowed to cool, and ground; then mixed with the solution, and again burned, to drive off the water; it is then ready for use.

VENTILATION OF MINES.

A PAPER has been read to the Academy of Sciences at Paris, by M. Faucille, on the means of enabling persons at work in mines, pits, reservoirs, &c., to continue their operations without danger or inconvenience from the carbonic acid gas which is found where there is not a free current of air. The means adopted by him are simple, and are based on the fact that this gas is rapidly absorbed by steam. He connects a hose or pipe, having its open end in the mine, pit, or reservoir, with a steam-boiler of any kind, and thus sends a supply of steam into the place where the gas exists.—*Athenæum*, No. 966.

NEW VENTILATOR.

DR. ALDIS, Physician to the London and to the Surrey Dispensary, deploring the usually vitiated state of the air in the habitations of the lower classes, has contrived a New Ventilator for windows, cheap and simple, which promises to be serviceable. It consists of a small pane of glass in a hollow tin frame, in the outer face of which frame are openings; these communicate with a wide flat tube on either side, attached to the two upright sides of the frame, curved inwards, and perforated with small holes on the under side.

HALEY'S PATENT LIFTING JACK.

THIS is a most important improvement on the old rack Jack for lifting great weights, supporting beams, &c., in buildings undergoing alteration; and from its simplicity, power, and economy in first cost, must come into very general use, if not entirely supersede the ol

and rude rack jack. Instead of a rack with ratchet wheel and pinion, in the one to which our notice has been directed a powerful screw runs perpendicularly through the frame, having a claw at both top and bottom, so as either to raise the weight from above, or lift from below; this screw is acted upon by a pinion taking into an endless screw, on the axis of the handles outside the machine, by which means a most enormous power is obtained with comparatively little labour: the handle may, at any time, be left without a possibility of flying back; it is only half the weight of an ordinary jack of equal power, and one capable of lifting five tons can be borne with case by one man. All its working parts are most accurately finished, being engine cut, and it combines utility, safety, durability, and neatness, at a cost not exceeding that of the old and unsafe jack. It is manufactured solely by Messrs. Galloway, Knot Mill Iron-Works, Manchester.—*Mining Journal.*

IMPROVED SAFETY GUN-LOCKS.

M. Guérin has announced to the Academy of Sciences, at Paris, an improvement in the construction of Gun-locks, with a view to prevent explosion by accident. M. Guérin renders the motion of the trigger impossible without pressure upon a spring, which is protected from accidental collision. This spring may be so contrived as to be known only to the owner of the gun, and thus children and others playing with fowling-pieces would be unable to commit mischief.

CASK-MAKING BY MACHINERY.

Considerable sums of money have at various times been expended in trying to bring to perfection Machinery for Making Casks; but heretofore this object has been unattained, some parts having always to be finished by manual labour. A very ingeniously constructed machine has at last, however, been constructed by Mr. W. Wild, of Bedford-street, Broughton-road. The lags or staves, hoops, and heads, are, in the first instance, dressed off by other machinery, which has been constructed for the purpose; afterwards, the finishing machine is fed with the previously-prepared heads, hoops, and staves, and will in two minutes' time turn out a complete barrel, vastly superior in workmanship to what has hitherto been effected by manual labour. Old barrels can also as easily be repaired by the same machine, the only difference in time being occupied in the taking to pieces of the old barrels previously to substituting such fresh staves, heads, or hoops, as may be required previously to feeding the machine. The barrels, when completed, are vastly superior to any heretofore turned out by manual labour, the machine fitting each stave as closely as though the whole barrel had been formed of one piece of timber; thus doing away with the necessity, when made by hand, of filling up any defects with rushes, which plan it is well known has the effect of rendering *casks very foul,* unless extraordinary care be taken, and *consequently much* time occupied in thoroughly cleansing them.—*Manchester Courier.*

TURNING.

A PAPER has been read to the Society of Arts, by Mr. W. Everett, "On an improved Poppet-head for Turners":—"The first attempt at improving the Poppet-head, (observes Mr. Everett,) was to take off the point and insert a screw, carrying a spindle and wheel fitted up as a drill, to be driven by the overhead motion; and this I found answer very well when the hole to be drilled could be brought in a line with the drill. Having done this, I still anticipated that I could make this part of the lathe more useful,—in fact a substitute, in a great measure, for the slide-rest. The following motions have, therefore, been given to the point:—First, an upward and downward motion, so that it can be applied to all lathes. Secondly a circular motion, which enables it to be applied to any required angle; and thirdly, a motion directly across the mandril: and there is no motion but what is strictly mechanical, as each has a scale to guide the workman in its use."

PRINTING IN COLOURS.

MR. ADAMS, of Philadelphia, is stated to have invented a Machine by which any variety of Colours are Printed at one impression. The plan is somewhat like that of the ruling-machine. The ink-fountain is divided into sections, capable of enlargement or diminution, or variety of arrangement, at pleasure.

MANUFACTURE OF MECHLIN LACE.

MR. WATERHOUSE has described to the Society of Arts, his Machine for the Manufacture of Mechlin lace, exhibiting great capabilities. The number of warp-threads in the width alone is 700; and a corresponding number of bobbins or weft-threads are required, making a total of 9400 threads; which represent the same number of bobbins, and are all kept in motion at the same time. In making pillow-lace, it requires as many hands as there are bobbins; for, on the cushion, one hand must wait for the other, in order to obtain the requisite crossings of the threads. Some idea may therefore be formed of the intricacy of the machinery, and of the ingenuity displayed in its arrangement; as by it every motion given to the threads by the hand is exactly given by the machinery, but with much greater rapidity and precision: there were also various specimens of the lace exhibited—one of which was twenty-six yards long and four yards wide, and had four patterns woven upon it. The number of motions or throws that would be required to produce a similar piece of lace by hand would amount to not less than 2,111,616,000.

THE NEW CLAUSSEN POWER HAND-LOOM.

A NEW Loom has recently made its appearance in Ireland, which is deservedly attracting an extraordinary degree of attention, and seems likely to contribute, more than anything that has yet been brought forward, to furnish productive employment to the destitute poor of that unfortunate country. This loom possesses many valuable

properties; but there are two which recommend it above all others to public favour: the first is, that it has reduced weaving to so simple an affair, that a man or boy, woman or girl, may be taught the art, and enabled to gain a good livelihood by it, in a couple of days; the second is, that a single hand can weave by it, in any given time, about thrice as much cloth as was ever before woven in the same time by hand-power.

The loom—which is called after its importer, (for it is a foreign invention,) the Claussen Loom—was first exhibited in the sister kingdom at the meeting of the Royal Agricultural Society of Ireland, held at Limerick, when the first prize and a silver medal were awarded to the exhibitor. It was then shown at Belfast to the Royal Society for Improving the Growth of Flax, and a trial made of it in the presence of a committee of the members, which established beyond all doubt its vast superiority over the ordinary hand-loom. In 4½ hours, a loom, which was the best of the common kind that could be procured, and worked by a strong and expert hand, produced only 2 yards 2½ inches of yard-wide linen; while the Claussen loom produced in the same time 5 yards 13 inches of the same description of cloth.

The Claussen Loom is of this universal utility, because, in the first place, it is one of the simplest of things to work imaginable. A man has but to be taught how to turn a crank and tie up a thread, in order to be made a good weaver. The simple turning of the crank is made to produce all the other numerous and seemingly-complicated movements of the loom.

In ordinary hand-loom weaving, the workman, as he sits in front of his loom, is required to give three distinct motions to it. First, by means of his feet, he depresses the treddles, and thereby divides the threads of the warp, to form the shed for the passing of the shuttle; secondly, by his right hand, he drives the shuttle, which carries the weft through the opening or shed just made; and thirdly, with his left hand, he pulls the batten containing the reed towards him, to drive up the thread of weft which the shuttle has left behind. Each of these movements is reciprocatory and intermitting; and therefore, during every change from one movement to the other, there is necessarily time lost. The loss each time may be small, yet the aggregate time thus lost, during a whole day, amounts to something very considerable. Now, this loss is entirely superseded by the Claussen Loom; for, though the several motions required for lifting the warp, throwing the shuttle, and driving home the weft, are all required to be done in this machine, yet the whole of them are effected by one movement on the part of the workman, who stands in an easy position in the front of the loom, and gives the rotary motion to a crank-handle. And in proportion to the greater number of throws which he is thus enabled to impart to the shuttle in a given time, there is, of course, an increase in the quantity of cloth produced.

For *further details and illustrations*, see the *Mechanics' Magazine*, *Nos. 1216 and 1217.*

WORKING PLASTER OF PARIS.

A PAPER has been read to the Institute of British Architects, on "A New Mode of Preparing Plaster of Paris in an Economical Manner for Solid Construction and for Plastering," by M. Delassaux, Architect. It appears that English plaster stone is a sulphate of lime, destitute of water, and containing but a small portion of sulphuric acid, being only fit for internal plastering; whereas the stone of the French plaster in the environs of Paris, is composed in the best proportions of acid and the bases; and when properly burnt, preserves its acid properties, and becomes fit for exterior decorations; for this purpose it is extensively used in France, as also for the grouting of the stonework and for other purposes, to which, in this country, mortar is applied. Many of the public buildings of Paris are erected in this manner; and the plaster has been even employed with iron in the construction of the Circus, which is wholly built with these materials,—a method uniting incombustibility with extreme facility of execution. The other advantages obtained by using it for building purposes are quickness of setting and of drying, rigidity, strength, and cheapness.

WOOL-DRESSING.

M. PAGNON has submitted to the Academy of Sciences, at Paris, a paper on the means of rendering of use the refuse water from the washing of Wool. Hitherto the only use made of it has been the separation of the fatty matter, and its conversion into gas for light. M. Pagnon, by the addition of potass and slacked lime, converts this water into a soapy liquid, which he applies successfully to various purposes, and particularly to the cleansing of carded wool.

GLASS TILES.

MR. JOHN RUSSELL, of Edinburgh, has patented the "Manufacture of Glass Tiles," or forming pieces or sheets of glass of convenient size, with two of their respective or opposite sides bent or turned up about half an inch, according to the size of the tile required; so that the two opposite sides will stand perpendicularly to the plane or surface of the glass, the flanges being so turned that the plane of the tile will be broader at one extremity than the other. The flanges may be turned at any angle, either inwards or outwards, as occasion may require, or else curved; and the tiles can be formed at any angle or curve, so that they may be fashioned into hips or cupolas for domes or arcades, and may be made of stained or coloured, and also opaque glass for roofs.

The roof for supporting the tiles is built in the usual manner, with rafters and laths between them, running parallel to the side walls for the purpose of receiving the flanges of the tiles. The apertures between the flanges may be filled up with putty or any other suitable cement, and covered with a hollow bead of metal or glass; else a thin slip of metal may be first screwed to the laths, and then brought between the junction of the tiles, and turned over at the ends.

GLASS MILK PANS.

The repeal of the duty on Glass, which led to the employment of this substance for pipes for the conveyance of water, has been succeeded by its use for Milk Pans, which are not only much more easily cleaned than metal, but may be scalded without any fear of fracture.

CHURCH'S PATENT COKE.

Mr. Church, the patentee of an Improved Method of Manufacturing Coke, commenced his experiments with the view to produce an article free from moisture, and less friable than that drawn in an incandescent state, and then quenched with water. His first experiment was, to allow the coke to cool in the ovens of the usual construction; but, from the great amount of heat retained, he found the plan too expensive, from the time it took to cool even a small charge. He then introduced cold air, by means of apertures under the floor; these he found had a beneficial effect: and, after various alterations and modifications, constructed the oven, which he has patented, by which he can burn off and cool down eight tons in ninety hours. When the coke is drawn, it requires no water to cool it, is much harder and compact than ordinary coke, and a larger quantity is obtained from a given quantity of coal. To remove all sulphur from the coke, Mr. Church uses a powerful galvanic battery, to convey a current of electricity through it while in the oven.

THE VALUE OF SMOKE.

The following striking instance of economic talent, in the district of Alston Moor, is recorded in the *British Quarterly Review*. From the smelting hearths of one "house," an arched tunnel conducts the smoke to an outlet, at a distance from the works, in a waste spot, where no one can complain of it. The gathering matter or "fume," resulting from the passage of the smoke, is annually submitted to a process, by which it had at that time yielded lead enough to pay for the construction of a chimney. A similar tunnel chimney, three miles in length, was erecting at Allendale. Its "fume" will yield thousands of pounds sterling per annum! Truly, here it may be said that smoke does not end in smoke.

CONDENSATION OF SEWAGE INTO SOLID MANURE.

Mr. William Higgs, the patentee of this invention, has, in a lecture on the subject, proved the possibility of condensing, in a solid form, all that is valuable as Manure in the Sewage of Towns, by collecting it in tanks, wherein all that is solid and insoluble, or merely suspended in the fluid, would, of course, subside, while by aid of calcareous or other reagents, the soluble phosphates, or phosphoric acid, &c. might be converted into insoluble salts, and precipitated amongst the general sediment, or apart from it; and the ammoniacal and hydro-sulphuric vapours, uniting in hydro-sulphuret of ammonia, be

also condensed, by aid of chlorine, in covered air-tight areas above the tanks, and added, in form of sal ammoniac and sulphur, to the other valuable materials; the residual water of the sewage thus, in effect, being rendered perfectly pure before it issues into the river that may flow in the vicinity of the town. Into the question of the profitable and practical adoption, or the relative merits, of such an economical and save-all system, it is not our province to enter; but we may remark, that certainly the health of towns could not but be vastly benefited by the absorption and solidification of the volatile and unwholesome vapours hitherto permitted to emanate from sewers, and even by the purification of the rivers, on the banks of which the habitations of man are so frequently constructed.—*The Builder*, No. 190.

EXTENDED USE OF GAS—STATE OF THE MAINS.

The use of Gas in dwellings has greatly increased within the last two or three years, but by no means to the extent which may be predicted for it, if the proper steps be taken. Let it be cheapened, as it may be, and *means for efficient ventilation obtained*, and in a very short time a house not supplied with it will be an exception from the general rule.

Builders will lay down the pipes for it in the new houses as they now do for the water, and the community will be much advantaged.

"A remarkable circumstance," says Mr. Rutter, of Brighton (in a pamphlet on the 'Ventilation of Gas-lights'), "connected with the progress of gas-lighting, is that, of the many thousands of persons who have availed themselves of gas, never doubting that it was indispensable in their business transactions, so small a proportion until very recently should have thought it equally necessary to the comfort and convenience of their families. Those connected with the manufacture and sale of gas are in this matter more to blame than their customers. So far as the consumers of gas are concerned, their apparent indifference to its use in their private apartments is the result rather of passive acquiescence in present arrangements, than of any real objection to further improvements. In many cases, the cost of fittings, or the annoyance of having workmen about, may still operate as an insuperable difficulty. Let there be ever so large a deduction made for all kinds of objections and of prejudices, a vast number of persons remain who only require to have the subject brought judiciously under their notice, accompanied by an offer of advice or explanation by a competent authority, and they will use gas in their drawing-rooms and bed-rooms as readily as they now do in their counting-houses and shops."

PURIFICATION OF GAS.

Mr. Johnston's Patent for the absorption of the ammoniacal, *hydro-sulphuric*, and hydro-cyanic vapours, by means of sulphate of *iron, in the dry way*, or with barely sufficient moisture for the water of crystallization necessary in the interchange and formation of the salts, has been tried at the Horseferry Road station of the Chartered

Gas Company. Besides the purification, and the saving of 30 per cent. of lime (at the greater, though redeemed expense, of sulphate of iron, we presume), by this new mode of treatment, other advantages consequent on its adoption are, the reduction of the gross pressure of the liquid mode by 40 to 50 per cent., and the equivalent diminution of the consequent loss, besides the acquisition of the valuable products.

M. Peclet lately laid before the Society of Encouragement of Paris, a Machine for the Purifying of Hydrogen Gas used for lighting. It is composed of a horizontal cylinder, partly filled with lime water, the axle or axle-tree of which is covered with diaphragms of metallic canvas, turned slowly; the gas is introduced into this cylinder, and is stated to be much better purified than in the common apparatus in use.—*Mechanics' Magazine*, No. 1170.

NAPHTHALIZED GAS.

The judicial committee of the Privy Council have extended Mr. Lowe's Patent for naphthalizing gas, for seven years. At the hearing, Mr. Webster appeared in support of the petition, which was for the extension of the term of a patent "for increasing the illuminating power of coal gas," by passing it through naphtha. The mode stated in the specification as the most simple, was charging the gas-metre with this spirit in place of water; but the insurance-offices objected to having a large bulk of naphtha in one vessel; and to meet this, the patentee introduced the mode of saturating the gas in a separate vessel with the vapour of naphtha, by causing it to pass through a series of sponges charged with this volatile substance, which was found completely to effect the object, and to be unattended with either trouble or expense to the consumer; but, although the light thus produced was admitted to be superior to any other, the inventor had been unable to bring it into general use, and hitherto had received no return from it whatever.

Sir. J. Clark, physician to the Queen, said, he had used the naphthalized gas in his house for some years. It gives a clearer and more powerful light than coal-gas, with less heat: it produces fewer deleterious substances, and is therefore less injurious to health; also exhibits colours more clearly.

Mr. B. Hawes, director of the Chartered Gas Company, had used the naphthalised gas in his house, and thought it a great improvement. It gives a stronger and clearer light at less cost.

Dr. Reid said, he considered the naphthalized gas an important invention: it produced from 30 to 50 per cent. more light than common gas, with less heat. The effect is greatly increased by causing the gas to pass over warm naphtha, when it becomes more luminous according to the amount of oil absorbed. Mr. A. Smee, F.R.S. had used the naphthalized gas. With the same quantity of light there is less heat, with a saving of 20 per cent. in gas. It is also *more favourable to the* human countenance, and to the distinguishing of colours.—*The Builder*, No. 166.

IMPROVED GAS-BURNERS.

A GAS-BURNER of a novel and ingenious construction, called "The Universal Burner," has been introduced to the Institution of Civil Engineers, by Mr. M'Neil, the principal feature of novelty being the introduction of a stream of air to the centre of the flame by means of a hollow button in the middle of the burner. The air passing up through the hollow stem of this button, is heated, and passes out by two series of fine holes around the periphery, and impinging with some force upon the flame of the gas, curves it outward in the shape of a tulip, while the oxygen of the air mingling with the carburetted hydrogen gas produces a very perfect combustion. The flame is quite white down to the top of the burner, and it is very steady. It was stated that, in comparing the consumption of these burners with that of the concentric ring-burners, and trying the power of the two lights with the photometer, the new burner gave a better light, with a saving of rather more than one-third of the gas consumed.

Another Gas-burner, registered by Mr. Leslie, is of great advantage to gas consumers. In this, the gas issues from a number of capillary tubes placed concentrically, by which means very perfect combustion is insured.

AT a late meeting of the Statistical Society, Mr. J. Fletcher stated that, in London, the existing Gas Companies have eighteen establishments, and employ a capital of £2,800,000 in works, pipes, tanks, gasometers, and apparatus; the number of persons employed in this trade being about 2,500, besides 380 lamplighters, occupied in the care of 30,400 public lamps, which illumine the streets. The supposed advantages of competition in the supply of gas were said to be as fallacious as the imagined competition in the supply of water. On an average during the darker months, 890 tons of coals are every day consumed in the metropolitan gas works.

CAMPHINE LAMPS.

THE St. Louis Theatre, at Quebec, appears to have been burnt down through the mismanagement of some Camphine Lamps used to illuminate a diorama exhibiting there. The proprietor, unfortunately, did not take into his employ the person who understood the management of camphine lamps; he merely hired four of his lamps to be used with 200 oil lamps. The camphine which is used in North America is usually prepared by distilling turpentine, and is a very dangerous fluid to handle; it is very light, floats on water, spreads rapidly about if spilt, and water thrown on it only increases the danger without extinguishing the flame. The insurance companies at Quebec will not now grant policies for buildings wherein camphine is used.

ALLIGATOR OIL.

AN *Alligator* is found to be as useful in his way as a spermaceti *whale*. The oil which the former yields is said to be better for lamps

than even whale oil; and it is extracted from the animal in considerable quantity, and without any great difficulty. For this discovery we are indebted to the Indians, who have long been in the habit of extracting the oil of the alligator, and using it for various purposes. It makes a fine transparent fluid, and burns admirably.

NEW SUGAR MANUFACTURE.

MR. COLTAM has detailed to the Royal Institution, a new process of Manufacturing Sugar from the cane. Having described the process now in use, and noticed the inconveniences attending it—as, the large mixture of sap with the saccharine piece of the cane when it comes from the rolling-mill, the danger of fermentation from the large quantity of mixed liquor in the clarifier, the risk of fire in the boilers, and the waste of sugar occasioned by using the pressed canes as fuel,—Mr. Coltam exhibited a model of a new machine, now in use at Guadaloupe, by which these dangers and inconveniences are obviated, and a great saving of sugar ensured. In this new process, the cane is first cut in lengths of four feet, then sliced diagonally across the plant into shavings of about one-tenth of an inch thick (1,200 canes can be cut in one minute by this machine). The slices are then put into baskets, and immersed successively in six pans of water heated to 170° (a temperature which dissolves the sugar, but does not extract the sap). The syrup is then made to fall over a heated copper cone, where it becomes sufficiently concentrated for crystallization. The fuel used is anthracite coal, which is heated in a furnace fed by hot air and steam. This combustion supplies a current of carbonic oxide and carburetted hydrogen gases, which are circulated through the apparatus to give heat by their combustion wherever heat is required. The sliced cane is used as a manure.

At the conclusion of this communication, Prof. Faraday noticed the extreme beauty of the arrangement by which the heat, which had been elicited in the combustion of the coal, became latent when converted into gas, and therefore ready to be called forth when required. He observed, that the air took off part of the fuel in combustion, and so circulated it through the apparatus. This, he said, had been done in America.—*Literary Gazette*, No. 1533.

THE CREOSOTE MEAT-SAFE.

BY all the modes in which Creosote has hitherto been employed in preserving meat, it has acquired a disagreeable taste and smell. This Dr. Stenhouse has obviated by placing a small plate containing a little creosote immediately under each piece of meat as it hung suspended in the larder, and covered both over with a cloth. The creosote soon gave off vapours, which formed an antiseptic atmosphere around the meat, and kept it *quite fresh* three or four days longer than it would *otherwise have been. If* the plate be generally heated before the *creosote is put into it,* the vapours rise more quickly; and if the *additional precaution* be also taken of suspending the meat in a wooden

box, or earthen jar, which can be closed with a lid, the beneficial effect is still more discernible. Dr. Stenhouse has tried this process with invariable success; and a butcher, who also tried it on a larger scale in his shop, was equally convinced of its efficacy. The meat, when cooked, has not the slightest smell or taste of creosote.

There is also another advantage attending the use of the creosote. Its smell is so disagreeable to flies that it effectually frees a larder from the presence of these noxious insects. The same quantity of creosote may be used for several weeks; but on being long exposed to the air, it loses most of its smell, and is partly changed into a species of resin.

Creosote is not a simple proximate principle, as has been supposed, but consists of a mixture of empyreumatic oils, having different boiling points, and containing quantities of carbon, which, from some experiments Dr. Stenhouse has made, vary so much as from three to four per cent.—*Proceedings of the Glasgow Philosophical Society.*

DELL'S PATENT HYDRO-PNEUMATIC BED-WARMER.

THIS ingenious and useful domestic apparatus consists of a perforated metal cylindrical case, containing another cylindrical case, or tube, but made without perforations, so as to contain hot water, which may be poured in at the end, where a wooden handle is attached to a suitable metal screw-plug. This hot-water cylinder is suspended within the case, leaving a space all round for the circulation of air. To use the apparatus as a Bed-warmer, unscrew the brass nut by turning the handle, then take a tin funnel, or pour at once directly from a kettle sufficient hot water to fill the tube, which will now act as a heater; screw in the handle, and place the whole apparatus within, and at the foot of the bed, or wherever it may be wanted. Its operation is now simply this: all the air that passes through the lower perforations of the outer case coming in contact with the hot water heater is suddenly expanded, and escapes from the upper surface of the cylinder, and so on continually, as long as the water retains its heat. The consequence of this constant breathing forth (as it may be called) of temperate warm air, is, that not the feet alone, but the whole person, becomes enveloped in a bath of warm air, the agreeable effect of which is speedily felt by the warmth experienced about the neck and shoulders, remarkably different in effect to any other mode of bed warming ever hitherto adopted.

We have here only described the apparatus as constructed for warming beds; but it is manufactured in every variety of form, and for very different uses, as for feet warmers, and to be used as hot water stoves in nurseries, boudoirs, &c., and will be found desirable in sitting-rooms at those seasons of the year when warmth is required, although, *at the same time*, the heat of a fire or common stove is found to be *oppressive.—Mechanics' Magazine*, No. 1172.

DANGER OF LEAD CISTERNS.

MR. ROBINSON, M.B., in a letter to the *Athenæum*, No. 991, gives the following useful hint:—Any person possessed of a leaden cistern should forthwith get for it a *temporary zinc bottom*, to fit inside and to lay above the other. Leaden waterpipes might have an inch or two of zinc pipe screwed on at the end,—so that it may from time to time be removed and cleaned. Once a week or fortnight this bottom should be taken out and properly cleaned. The metal is wholesome, not expensive,—and malleable zinc will be the most convenient for the purpose. It should be added that, as sure as night succeeds to day, every particle of lead that may from time to time be in solution, will make for, or be precipitated on, the zinc,—there to remain till brushed off.

PREVENTION OF DAMP.

A PAPER has been read to the Institute of British Architects, by T. L. Donaldson, on "Damp in Buildings, its Prevention and Cure," founded on a treatise on the subject, recently written by M. Léon Vaudoyer. The object was to show the ill effects arising, in ordinary constructions, from damp entering the lower parts of buildings, by the footings and by the faces of the walls being in direct contact with the earth, or exposed to the rain and the humidity of the atmosphere. The advantages of having a thorough circulation of air about the walls, by means of external areas and internal casings, and the necessity of introducing into the walls, a little above the ground line, some substance impervious to wet, so as to check the damp rising from below. were strongly set forth and illustrated by numerous diagrams. —*Athenæum*, No. 970.

BRILLIANT WHITEWASH.

As every consideration of cleanliness and health prompts to the use of lime upon buildings, fences, &c., we give the following recipe for preparing the celebrated stucco whitewash, used on the east end of the President's house at Washington; colouring may be so added as to give any desirable tinge to the preparation:—Take half a bushel of nice unslacked lime; slack it with boiling water, covering it during the process to keep in the steam. Strain the liquor through a fine seive or strainer, and add to it a peck of clean salt, previously dissolved in warm water; three pounds of ground rice, ground to a thin paste, and stirred and boiled hot; half a pound of powdered Spanish whitening, and a pound of clean glue, which has been previously dissolved by first soaking it well, and then hanging it over a small fire, in a small kettle, within a large one filled with water. Add five gallons of hot water to the whole mixture; stir it well, and let it stand a few days covered from dirt. It should be put on quite hot; for this purpose it can be kept in a kettle on a portable furnace. It is said that about one pint of this mixture will cover a square yard upon the outside of an house, if properly applied. Brushes, more or less small, may be used, according to the neatness of the job required.

It retains its brilliancy for many years. There is nothing of the kind that will compare with it, either for inside or outside walls.—*New York Sun.*

AINSLIE'S BRICK BURNING KILN.

THIS Kiln, for drying and burning bricks and tiles, is composed of various compartments, by which the heat from the first passes into the second, from thence into a third, and so on—thus economising the fuel; and, when the tiles in the first are burnt, the second are half-burnt, to which the greatest heat is then applied, and the chambers are taken in succession—the thorough drying of the bricks being completed by using the heat after it has completed the burning. This new apparatus has been proved on a large scale; and, unlike the common method, by which, frequently, one quarter of the article is spoiled, in this every brick and tile is said to be as perfect in shape as it entered, and as thoroughly burned.

PALMER'S BRIGHTON HAND SHOWER-BATH.

A FEW years ago, a Hand Shower-bath was invented, made like a sugar loaf, with a cullender at the bottom and a handle on the top with a small hole, which was stopped with the finger while raised above the head, and on the removal of the finger the water fell. This was very inconvenient, from the height to which it was necessary to lift the hand. Mr. Palmer has succeeded in overcoming all the inconveniences of former contrivances, and has invented a Hand Shower-bath, which may be of any size, from half a gallon upwards. It is of an oval shape, the size of a pie dish, and has a handle at each end; the top is pierced with holes, of which two are larger than the rest, and lead to two pipes, which lead nearly to the bottom, and are easily covered with the two thumbs when lifted over the head and turned upside down, when the thumbs being removed, the water descends. The person stands in a tub or pan, to receive the water. He has then only to rub himself well with a towel. This invention is cheap, light, durable, and cannot get out of order.—*Mechanics' Magazine,* No. 1189.

CONCENTRATED GRAVY OF MEAT.

THIS article is manufactured at Sydney, New South Wales, from the carcases of oxen and sheep, which are bred there for the sake of their tallow, wool, hides, and bones. The value of oxen in Australia is from 15s. to 20s., and of sheep 1s. 6d. to 2s. 6d. each. During the last year the leg-bones of upwards of 109,000 oxen were sent over to this country, the greater part of the flesh of the animals having been thrown away. The object of the present manufacture is to render down the lean of the carcase into a solid portable soup, by stewing it down in its own gravy, without water, in double pans. By reducing it in this way, the water in the lower pan prevents the fire passing through and giving to the soup the burnt flavour which it has always hitherto had. When manufactured, it is sold in cakes of various sizes, at the rate of 2s. per pound. One pound of the soup is said to be equal to 24 pounds of the best gravy beef.

NEW BAKING OVENS.

A NOBLEMAN of Saxony has patented, in Germany, a Baking-oven on a new principle. Its chief characteristic is, that while our present ovens are heated from *within*, the patent Saxon oven is heated from *without*. The oven is built of stone, and capable of acquiring a greater degree of heat, and retaining it for a longer time, after the fire has ceased. It is obvious that all the present tedious and lengthy operations of heating a confined space, and subsequently clearing and sweeping it, are entirely obviated. An oven on the new Saxon principle can be worked almost constantly, and it is asserted that bread will be better and more savoury when baked in these stone ovens. There is, also, an apparatus attached for the lighting the interior of the ovens, all which the diagrams only can adequately explain. It is clear, that such ovens will as well bake meat, pastry, &c., and thus the time may soon arrive when people will only have to *wait* a few minutes, to take their prepared meals home.

MACHINE FOR BAKING BREAD BY STEAM.

THIS is stated to be the invention of M. Violette, and consists of two concentric cylinders between which steam at a high pressure is allowed to circulate. The interior cylinder contains the dough, which is pierced with a great number of very small holes; the steam which circulates between the cylinders penetrates by these holes into the interior, and distributes the heat uniformly throughout the mass; and after the lapse of half an hour the steam is let off, and the bread removed.—(*Moniteur Industriel.*) Of course, the bread will have to be dried after it has undergone this steaming process. A much better plan is that known in this country as James's Patent, in which the heat of the steam is conveyed indirectly to the bread through the medium of a number of cellular plates.—*Mechanics' Mag.*, No. 1182.

AMERICAN IMPROVEMENT IN THE BEEHIVE.

THE tubes that form the entrance to the reception chamber are surrounded by two flanches, in the form of inverted cones, containing water; the tube that forms the entrance from this reception chamber to the hive is surrounded by one such flanch also containing water, and within this tube there is a coiled wire which extends down a short distance into a cup of water, into which the moth will fall in attempting to get to the wire coil. The patentee claims as his invention, the mode of preventing the moth from entering the hive, and entrapping her by means of the upright metallic tubes and inverted truncated cones forming the entrance to the reception room of the hive, and the upright tube forming a passage between the chamber and lower box; all the said tubes being surrounded by inverted truncated cones, and containing water, and into which the moth is caused to fall, as described. He also claims combining with the vertical tube a spiral *rest upon which the bees cluster*.

COMMERCIAL VALUE OF INSECTS.

THE importance of Insects, commercially speaking, is scarcely ever

thought of. Great Britain does not pay less than 1,000,000 of dollars annually for the dried carcasses of the tiny insect, the cochineal; and another Indian insect—gum shellac—is scarcely less valuable. More than 1,500,000 of human beings derive their sole support from the culture and manufacture of silk, and the silkworm alone creates an annual circulating medium of nearly 200,000,000 of dollars. 500,000 dollars are annually spent in England alone for foreign honey: at least 10,000 cwt. of wax is imported into that country every year. Then, there are the gall-nuts of commerce, used for dyeing and making ink, &c., while the cantharides, or Spanish fly, is an absolute indispensable in materia medica.—*Boston Transcript.*

IMPROVED GELATINE.

MR. G. A. ARNEY, of Hackney, has patented certain improvements in the preparationof Gelatine, and its application in fining or clarifying liquids.

This invention consists, first, in an improved method of procuring gelatine in a dry powder; and, secondly, in clarifying and fining liquids. The advantage gained in the first part of the invention is by so treating the gelatine that it is rendered perfectly dry, by having all its moisture expressed, and thereby prevented from getting mouldy, and then reduced to a powder. The modus operandi is as follows:—He procures some common gelatine, and then places it in a stove or heated chamber, at a temperature ranging from 150° to 212° Fah., allowing it sufficient time to become perfectly dry. When it breaks easily, it is then sufficiently dry for breaking up in small pieces, and being then placed in a mill for grinding, is ground to a very fine powder. The inventor prefers the common hand coffee-mill, known by the name of horizontal post coffee-mill, for this purpose.

The gelatine being thus prepared for making jelly, he mixes with it refined sugar, citric acid, essence of lemon, in the following proportions; care, however, being taken that the sugar, citric acid, and essence of lemon, be well mixed together before adding them to the gelatine:—To 9 lbs. of gelatine add 18 lbs. refined sugar, 10 oz. citric acid, and 3 oz. essence of lemon. And for making blancmange:—To 9 lbs. of gelatine add 15 refined sugar, 5 drachms carbonate of potash, 5 drachms of essential oil of almonds, and 1 oz. of essence of lemon, the same precautions being observed in mixing the ingredients for the blancmange as for the jelly. After being intimately mixed, he then bottles it off for sale, 6 oz. of the first mixture being sufficiently strong for 1 qt. of jelly, and 5 oz. of the latter for 1 qt. blancmange.

The powdered gelatine may also be used for thickening soups, hashes, and all descriptions of made dishes, to which it will be found a great improvement; and it may be used as a portable soup by mixing 7 lbs. of farina or farinaceous vegetable compound to 10 lbs. of the powdered gelatine, flavouring it with essence of meat and culinary herbs, or their essences, as are generally employed to flavour dishes.

The second part of the invention relates to an improved method of fining liquors with the above gelatine and a small proportion of tannin (catechu).

DIAMOND DUST.

The demand for Diamond Dust within a few years has increased very materially, on account of the additional demand for all articles that are wrought by it: such as cameos, intaglios, &c. Recently there has been a discovery made of the peculiar power of diamond dust upon steel: it gives the finest edge to all kinds of cutlery, and threatens to displace the hone of Hungary. It is well known that in cutting a diamond (the hardest substance in nature) the dust is placed on the teeth of the saw, to which it adheres, and thus permits the instrument to make its way through the gem. To this dust, too, is to be attributed solely the power of man to make brilliants from rough diamonds; from the dust is obtained the perfection of the geometrical symmetry which is one of the chief beauties of the mineral, and also that adamantine polish which nothing can injure or affect, save a substance of its own nature. The power of the diamond upon steel is remarkable: it is known to paralyze the magnet in some instances; and may there not be some peculiar operation upon steel with which philosophers have not yet taught us to be familiar? How is it that a diamond cast into a crucible of melted iron converts the latter into steel? Whatever may be said, it is evident that the diamond dust for sharpening razors, knives, and cutlery, is a novelty which is likely to command the attention of the public, whether or not it be agreed that there is anything *beyond* the superior hardness of the dust over the steel to give that keenness of edge that has surprised all who have used it.—*Church and State Gazette.*

FABER'S EUPHONIA, OR SPEAKING AUTOMATON.

This novelty in the way of exhibition consists of a draped bust and waxen-faced figure, which articulates language almost as intelligibly as is done by the human organs in individuals who do not speak very distinctly. The sounds are produced by striking on sixteen keys. There is a small pair of bellows, which is worked with the nozzle into the back part of the head; and the physical powers, we are informed, are adapted to India-rubber formations similar to those in nature. How these, in such a material, can be brought to emit and modulate sound, is not easily com prehended; but the mouth does move up and down, like the nutcracker toy, and the sounds are heard in sentences. Whispering is also managed, which has a very odd effect, and from the mouth the wind of the bellows is perceptible to feeling. We have seen and heard Prof. Wheatstone's remarkable essay in this line; but Mr. Faber's is altogether dissimilar, and does more than Mr. W. attempted.—*Literary Gazette*, No. 1540.

NEW TELESCOPE-STAND.

Dr. Green has described to the Society of Arts his invention of "a new portable Stand for Telescopes, with an equatorial movement, but *without a polar axis.*" The true principle upon which every *stand ought to be constructed*, according to Dr. Green, is to have the *heaviest end of the telescope* supported on a solid foundation, and the

moving power placed as far as possible from the centre of motion. To this end is the improved stand constructed; and, as a triangular support is found to be the most steady, it has been adopted in this case, and pervades almost every part of the new arrangement.

BOYDELL'S PATENT HINGES.

MR. JAMES BOYDELL, of the Oak Farm Iron-Works, has just obtained a patent for improvements in the manufacture of Hinges, both iron and brass. The first improvement consists of casting hinges, with the pivots on which they turn, in one piece. In order to accomplish this, one flap is cast, provided with a suitable core in the shoulder to receive the pivot on which the hinge is to work. After this flap is cast, and the cores are removed, the other flap is cast upon its edge in such manner that the two exactly fit, and the fluid metal entering the core in the first flap forms the necessary pivot. The second improvement consists in a mode of casting brass hinges, when separate pins or axes are to be applied, after the flaps are cast. They are cast on cores not going quite through at one end, and with a little projection at the other; so that, when a pin of the proper length is introduced, the excess of metal is beaten down and filed off, and the pin is completely inclosed. The third improvement consists in casting the flaps for several hinges in one piece, and then dividing them. In casting flaps for hinges, it has been usual to have a separate mould for each flap, although several moulds are made in the same box; but the patentee proposes to cast a length of—say six, for instance,—with projections on the mould to form grooves, where they are to be divided, so that each hinge can then be broken off, and finished by grinding. A fourth improvement consists in annealing cast-iron hinges in coke ovens.—*Mining Journal.*

IMPROVED FASTENINGS, KNOCKERS, &c.

MR. COTTERILL, of Birmingham, has obtained a patent for numerous curious arrangements in respect of Locks, Bolts, Knockers, &c., which may be thus described. His improvements in locks consist in introducing spiral springs for the purpose of acting on the bolts when released; and also arranging the other parts so that the bolt may be withdrawn by means of pressure on a knob in the centre of the handle, which acts on a wedge, and thus displaces the bolt from the staple. In latch-locks, the internal part is so arranged that, by turning the handle in either direction, the latch is lifted up; it is also replaced again by means of a spiral spring. In his improvements in knockers and bells for hall-doors, the knocker, instead of being placed outside, as at present, is fixed inside the door, and has a spindle projecting through to the outside. On this is placed a small wheel, with a handle for the purpose of driving it round; on the axis inside the door is placed a sort of ratchet-wheel, with two or three teeth, which, as they revolve, raise the knocker, which falls by its own gravity, the continuation or rapidity depending on the number of teeth and the rate at which the wheel may be driven. Door-bells are also applied in a similar manner at the back of the door.

LATH-CUTTING.

An improvement in the Lath-cutting Machine has been patented in America by Solomon F. Finch and James Wheeler, who found their claim on the division of "the carriage which carries the bolt or block to the knife in two parts, moving on each other, and connected together by a spring or analogous device, so that the bolt is griped whilst being carried to the edge of the knife, and still griped until drawn back off the edge of the knife, and then liberated."

PAINTING ON GLASS.

A well-informed correspondent of the *Athenæum* states, that the whole secret of the "lost art" of Painting on Glass,—the production of red glass, in every way equal to the ancient mode, consists in this:—though the *deutoxide* of copper, when melted with glass, gives a green or sky-blue colour, the *protoxide* gives the red in question; this, by reflected light, is dingy, but by transmitted light beautifully splendid. The difficulty is, that it requires much skill and practice on the part of the workman to prevent the copper, while the glass is in fusion, from taking up the additional dose of oxygen, and thus passing from red to green. There is another part of the secret, which is not a little curious: that glass, though containing the proper oxide of copper when first taken out of the pot, often shows only a dirty greenish hue; yet nothing more is needed for throwing out the fine red tint than to expose the brown glass for a few minutes to a dull red heat. Modern artists, it may be added, have discovered a substitute red, which seems to have been unknown to the ancients,—viz., the red from silver; which, though sometimes fine, can seldom bear comparison with the old red.

TO ETCH ON GLASS.

The following new mode is stated in *The Art Union* to be the invention of a German:—The plate glass is covered with a very thin coating of bitumen and wax, a coating of sufficient thickness only to be continuous upon the surface of the plate; through this the design is traced with a sharp steel needle, and etched as in ordinary etching; the plate is then subjected to the action of the solvent, the effect of which may be regulated to a nicety; when this action has continued sufficiently long for the delicate parts, they are stopped out, and the stronger lines further bitten, until the effect is complete. The glass plate is then rendered thicker by plaster of Paris, so as to resist the pressure in printing. The great advantage of this process is in the solvent employed; this is as yet kept secret by the inventor, but it will, we believe, be given to the world. The engravings by this process possess extraordinary sharpness and delicacy, and the plates do not wear like copper or steel.

GLASS-CUTTING AND BORING.

Dr. Ryan, the eminent chemist, has lately promulgated a fact which may prove practically useful. The Doctor states that if a solution of

camphor in turpentine be applied to the usual cutting instruments to moisten them, instead of emery or sulphate of copper, Glass may be cut and bored just as easily as metals or other substances.

NEW METHOD OF FINISHING BRONZE STATUES.

THE bronze statue of Huskisson, lately completed in the royal brass foundry of the Bavarian capital, deserves an especial notice, on account of a new method of chasing which has been resorted to in this case. It is known that newly-cut brass possesses a strong lustre, which destroys the mellow aspect of the work; on which account artists have resorted to the expedient of producing a sort of artificial *patina* by the use of mineral acids. For the sake of imparting to the above work an uniform mellow appearance without using acids, Inspector Müller has resorted to the method of dead chasing. This has been perfectly successful; and the uniform tone which has been obtained in the whole work, bids fair that the *patina*, as it will appear in due course of time, will be also uniform. By the use of different sorts of files, a really different *grain* of the metal has been cut out, which the artist has produced in accordance with the nature of the part thus treated. This method is said to be a real advance in the mechanism of the bronze-founding process.

BUST-TURNING MACHINE.

MR. THOMAS BLANCHARD, of Boston, U.S., has invented a piece of mechanism by which nature, art, everything tangible, can be copied, with a precision which defies the chisel, even when guided by the most skilful hand and directed by the most gifted talent. The machine, too, can be graduated so as to give reduced copies of any statuary; which shall, in their miniature, be perfect and exact copies of the originals in everything else but the size,—preserving every line, furrow, and dimple, and giving prominence to muscles and veins, and every particular lineament and feature, in exact proportion. By the same machinery, the most correct perfect bas-relief profile likenesses may be cut, on the hardest material, and of any size required, from half an inch to full life-like size.

CAST-MARBLE STATUES.

A CORRESPONDENT of the *Literary Gazette*, No. 1558, announces that at Berlin, and in the newly erected factory at Charlottenburg, Cast-Marble Statues may be seen resembling both in transparency and hardness those made of the finest Carrara marble. They are cast in the same way as figures of plaster; and the cost is not more than 1 thaler (2s. 6d.) per cubic foot. MM. Möser and Kriegk are the inventors. In the same factory may be seen figures the size of life, of a reddish-grey material, harder than sandstone, and closer grained, made *out of the sweepings of the roads!* Four figures of soldiers—a life-guardsman, a hussar, a cuirassier, and an artilleryman—made of this composition, are at the Berlin Exhibition: they were to be placed before the newly erected war-office. M. March, the inventor, has during a

long time employed this material in making vases after the antique small statues, and ornamental mouldings.

EARL'S GONIOMETRICON.

This is a contrivance to enable persons unskilled in drawing to find the perspective direction of the vanishing or receding lines of objects. The mode of using the instrument is thus described by Mr. Earl :—Place the instrument between the eye and the object to be outlined, which is done by holding it with the finger and thumb of the left hand, at a point between the top of the arc and the universal joint. It is then fixed in that position at an angle of 60 degrees with the line of vision; a task accomplished by taking a small ivory acorn attached to the instrument by a string, and placing it firmly between the teeth, when the connecting string is stretched to its fullest tension. This done, the instrument is moved till one of the indicators coincides with the line whose downward or upward direction it is sought to ascertain. That point discovered, the instrument is laid flat on the drawing-paper with the horizontal bar parallel with its lower line, and gently moved to the required position, when the line of direction is ruled off from the edge of the indicator. The bottom of the instrument is set with divisional points, to assist in sketching the proportions of figures, trees, and objects of irregular form or outline.

The Goniometricon is much used by artists and travellers, and recommended for general use by the Astronomer Royal.

LONGMORE'S PATENT ELONGATING EVER-POINTED PENCIL.

The latest and most popular improvement in the Ever-Pointed Pencil is that patented by Mr. Josiah Longmore, embodying improvements in the "motion part" of the pencil case hardly to be understood or appreciated except by manufacturers of the article. The most prominent peculiarity consists in the elongating action of the case, by means of which the writing-point is protruded. The act of extending or contracting the case propels or withdraws the writing point, so that a three-inch pencil for the pocket becomes a five-inch pencil for writing with. In addition to the convenience afforded by this arrangement, the objectionable external sliding ring is done away with; neither is there is any slit to weaken the case, admit dirt, or cause derangement.—*Mechanics' Magazine*, No. 1207.

MANUFACTURE OF INDIAN PAPER.

Captain Postans has described to the Asiatic Society, the native Manufacture of Paper in India. The principle in nowise differs from the old European mode, with the modifications rendered expedient by difference of climate and material. The latter is the ordinary coarse hempen bagging used by the *bringarries*, when torn to rags in their service. These rags are cut into small pieces. and thoroughly washed in the numerous tanks which environ the town (Kharguzpoore, or Paper-town, near Rozah, in the Dekkan), the water of which is said to be peculiarly adapted for the purpose. The tanks are always sur-

rounded by workmen, employed in washing, bleaching, and drying the rags; which, in about twelve days, are converted into a white pulp, and then made up into balls weighing about 4lb. each, and as big as a man's head. These balls are subsequently mixed with water in a small tank; and then made into paper upon a frame, precisely as in the old European mode, except that the frame is made of fine reeds instead of brass wire. A man and boy are employed in making the sheets; which are removed by a third workman, who first presses them under large stones to expel the moisture, and then plasters them against the walls of the manufactory to dry in the sun. The paper is afterwards covered with a gummy size, and polished by rubbing with smooth stones.

TO "PICKLE" OAK.

A CORRESPONDENT of the *Builder*, No. 151, suggests that to make old dark Oak pale in colour, apply with a brush a little dilute nitric acid, judiciously; if required to be dark, stain it with dregs of black ink and burnt umber mixed. It is better at first to try these plans on oak not of much value, as to make a good job requires care, practice, and attention.

TO TAKE PAINT OFF OAK PANELING.

THE best and only method of removing Paint from Oak Paneling, carving, &c. is as follows:—Make a strong solution of American potash (which can be bought at any colour shop, and resembles burnt brick in appearance); mix this with sawdust into a sort of paste, and spread it all over the paint, which will become softened in a few hours, and is easily removed by washing with cold water. If, after the paneling, &c. is dry, it becomes cracked, apply a solution of hot size with a brush, which will bind it well together, and make it better for varnishing; as well as destroy the beetle which is often met with in old oak, and is erroneously called the worm.—*The Builder*, No. 151.

ORNAMENTAL FLOORS.

MR. LAUGHER has read to the Decorative Art Society a paper on "Ornamental Floors," principally with a regard to modern appliances, and more particularly to the use of parquetry (or inlaid wood) in our principal apartments.

Several observations, however, were made respecting the pavements and floors of antiquity, of which not a few familiar imitations were referred to in the painted floor-cloth of the present day. It was observed, that boarded floors (usually of oak) were considered a very distinctive appurtenance to the English mansion in the 17th century, and that they received increased attention to ornamental effect in the early part of the 18th century, at which period the parquet floors had obtained considerable favour, and were constructed at great cost. Carpets of home manufacture then began to enter into competition with them, and the use of foreign deals (which, from their shrinking, rendered carpeting more essential to comfort,) tended to the disuse of

this superior kind of flooring. It was remarked, that at present there was a revival in the feeling towards parquetry, and some explanations were given of several applications of steam and machinery, by Messrs. Steinitz and Co., for accelerating not only the production of the geometric forms of the component parts, but ulterior processes of framing and construction, whereby considerable economy in time, labour, and cost resulted. Several observations passed upon the relative cost of parquetry, and it was said that its price, laid down marginally in dining-rooms, does not now exceed four times that of its imitation on painted cloths, and that for drawing-rooms it is not more expensive than the richer kinds of carpet.

RE-DECORATION OF HER MAJESTY'S THEATRE.

The re-decoration of this magnificent theatre was commenced last winter, and effected in the incredibly short space of ten weeks, including stripping the old house, and re-canvassing, preparatory for the paintings. We quote the following details and judicious remarks on this highly successful work from No. 162 of the *Builder*:—

"Many persons have necessarily been employed upon it; and to all great praise is due. The Raffaelesques were chiefly directed by Mr. Sang and his German corps. Mr. Marshall, the artist attached to the theatre, assisted by Mr. Wright, has ably executed the most important subjects, including the ceiling. The figures in the medallions, and in the panels, of the first tier, were executed by Mr. Powel and his assistants, Mr. Dessurne, Mr. Fox, Mr. Roho, Mr. Shaw, and Mr. Earl, all students of the Royal Academy. But the merit of the work as a whole is due to Mr. John Johnson, architect, of the Adelphi, who went into Italy as travelling student of the Royal Academy. Some time since, Mr. Johnson designed the decorations of the Earl of Pembroke's mansion in Carlton Gardens, and this led to his introduction to the manager (Mr. Lumley), who employed him in the work under consideration, without any limitation or control.

"Considering that other styles of decoration had become hackneyed, he resolved to adopt the style used by Raffaelle and his pupils, which he had studied carefully in Italy; and he has carried out his intention most successfully. The chief merit of the design—its oneness, its accordance and continuity—is the result of one mind having controlled the whole.

"We shall not attempt very minute description of the ornaments. The front of each tier of boxes is varied both in design and character. The lower tier has medallions from Raffaelle, Giulio Romano, and Pompeii, in centre of lozenge-shaped panels, containing figures on a chocolate-coloured ground. The next tier has also figures, on metal back-ground. The succeeding tiers are more purely decorative, and the embellishments, as they approach the roof, become progressively lighter. The ceiling, taken in part from the Villa Madama, connects historical and decorative art, and contains Albano's "Four Elements," with copies of other celebrated works; and over the proscenium is the "Aurora" of Guido charmingly enwreathed.

"The tone is perfect. Notwithstanding the infinite variety, the life and movement of all the parts, the effect of the whole is subdued and unobtrusive; and the eye wanders from point to point, pleased and never tired, to rest ultimately on the stage, which is decorated with a drop-scene executed by Stanfield, with the aid of Mr. Telbin and Mr. John Absolon. The scene is architectural, of the same character as the decorations of the house, and by its arrangement gives the effect of great space to the stage.

"When looking towards the house from the stalls or pit, a charming effect is observable in the gallery: *the ceiling* is coloured blue, and, as seen beyond *a broad band of Raffaelesques,* the termination of the ceiling of the vaulted *house gives the notion of* a brilliant night in a more balmy land."

IRON MARKET-HOUSE FOR HONDURAS.

At the Phœnix Iron Works, Messrs. Thomas Edington and Sons, of Glasgow, have constructed a very elegant and extensive Market-place for Honduras, wholly composed of Iron. It measures 180 feet long, and 60 feet wide, and is surrounded by a colonnade or verandah 12 feet wide, supported by handsome fluted columns. The interior or main building contains numerous stalls for the sale of the various market commodities, and is ventilated by means of jalousie blades, fixed in the manner of Venetian blinds, which exclude the rays of the sun, while, at the same time, they afford free ingress to the current of air. There is besides a large ventilator on the top, that nothing may be wanting to encourage the delicious coolness in the hot climate for which it is intended. When erected in Honduras, it was to occupy the centre of a large square, or open space of ground, and will be entered by four spacious doors, one in the centre of each side of the building. In the construction, due attention has been paid to ornament and architectural beauty; whilst, at the same time, lightness, combined with great strength, have been carefully studied.—*Glasgow Journal.*

THE ROOF OF WESTMINSTER HALL.

The celebrated Roof of Westminster Hall, the span of which is among the greatest ever built without pillars, is little more than one-third the width of the Worksop spread oak, the branches of which would reach over Westminster Hall, placed on either side of its trunk, and have 32 feet to spare; and its extent is nearly 30 feet more than the length, and almost four times the width of Guildhall, in the city of London. The rafters of Westminster Hall, though without pillars, have massive walls on each side to support them; but the tree-boughs, of 16 feet more extent, are sustained at one end only. Architects, who know the stress a staircase of even 8 or 10 feet in width has upon the wall into which the side is built, can alone fairly estimate the excessive purchase which branches on either side, spanning from outbough to outbough 180 feet, must have on the central trunk.—*The Plough.*

NEW PAINT.

Mr. H. Page has patented an Oil Integument, or Skin of Paint, by which facility is afforded for interior or exterior decorations. The patentee, after pointing out the various inconveniences which the public experience, in having the painting, graining, and oil decorations done on the premises, proceeds to show some of the advantages which he obtains by substituting a prepared skin of paint for the ordinary common painting. These advantages are apparent in the decoration of ceilings, or in the execution of any kind of flat ornamental work, whether it be imitation of woods, marbles, lettering in gold or colours, on walls or woodwork; as it is only necessary that the dimensions of the parts to be ornamented should be previously taken, and the work can be completed at the artist's shop or study. The author next describes the process of manufacture, remarking that the skins at

present made are 12 feet by 3 feet, that being found the most convenient size, but they can be made of any dimensions. The mode of fixing the skin is to rub down the surface on which it is to be fixed; when thoroughly cleaned, it is gone over with boiled oil and gold size (a smear is sufficient), and the skin is then laid on with a soft cloth, as in the ordinary paper-hanging.—*The Builder*, No. 150.

COLLAPSIBLE METAL TUBES FOR PAINT.

Mr. Rand has communicated to the Society of Arts his invention for the manufacture of Flexible Metal Vessels for Preserving Paint and other matters. They are formed of so thin a body of metal that they are capable of being collapsed so as to shut out all air. The tubes are made of block-tin, the 150th part of an inch in thickness; they have at the upper end a nozel and screw-cap, and are closed at the bottom by being folded over once or twice with a pair of pincers, so as to exclude all air. As the colour or other matter which they contain is pressed out, the tubes are collapsed, and thus the upper part of the tube always remains full. Each tube has to go through the following process of manufacture:—A small piece of block tin is put into a dye, upon which a punch, worked by a fly-press, descends and forces the metal up of the required thickness between the surfaces of the dye and punch; thus by a single blow the body of the tube is formed. It is then removed to a second press, by which the screw on the neck of the tube is formed, and by a second blow in the same press the maker's name is stamped upon it. The cap is formed in a similar manner by a third machine. The tube, when struck, is placed in a lathe, and cut the required length. Thus, a perfectly air-tight bottle is formed without seam in a few seconds. Essence of anchovies, prepared mustard, cold cream, and volatile chemical preparations, are kept in these tubes; it is also intended to export and import butter, preserved meats, and other substances, in cases of this description.

GUTTA PERCHA.

In the *Year-book of Facts*, 1846, p. 73-75, we gave an outline of the economy of "Gutta Percha," or, as it is sometimes called, "Gutta tuban," which, in the opinion of judicious persons, "seems likely, at no distant day, to supersede the use of caoutchouc in many articles of manufacture, and to be applied to many more for which caoutchouc is wholly unsuitable. Like caoutchouc, it is of a strongly adhesive or agglutinating quality, and perfectly repellent of water; but it is advantageously distinguished from it in being entirely free from stickiness when dry, in being nearly inodorous, in resisting the action of grease and oil, in mixing readily with paints, pigments, and other colouring matters: and, above all, in becoming, by *mere immersion in warm water, so soft* and ductile that it may without further *treatment be kneaded, or moulded, or rolled out, or pressed into any desired shape, or even spun into thread!* It may be sulphurized, too,

like caoutchouc, and rendered thereby equally proof against all variations of temperature."—*Mechanics' Magazine.*

Six different applications of this article to manufacturing purposes have been patented by Mr. Hancock, which will be found detailed in the *Mechanics' Magazine.* Mr. A. Parkes, of Birmingham, has likewise patented certain methods of rendering caoutchouc, or gutta percha, or combinations of caoutchouc and gutta percha, less liable to be affected by change of temperature than when in a pure state. For carrying out these improvements, the patentee subjects the caoutchouc to certain processes, by a new solvent, by means of gases, &c.—*(See Patent Journal,* No. 21.)

IMPROVED STRAPS AND BANDS.

Mr. W. Wharton, of the Euston Square Station of the London and Birmingham Railway, has patented the construction of Straps and Bands used for harness, hanging carriages, driving machinery, securing luggage, &c. It consists in combining leather and strands of metal wire, or gutta percha, and strands of wire, or both leather and gutta percha, with strands of wire.

To form a trace or strap, he inserts two strands of wire between two thicknesses of leather, having previously cut grooves in the leather at equal distances from the centre, near the edge of the strap for their reception; and after roughly stitching the wire strand to one thickness, the whole is stitched together. Or, instead of cutting grooves, the wire strands may be stitched to the inside surface of the strap, and a strip of leather placed between them, the thickness corresponding with their diameter; the other half of the strap is placed on this, and the whole stitched together, the edges of the leather at the same time being drawn around the wire strands, and thus completely enclosing them. Where a buckle is attached to the end of the strap, the strands are divided and carried round that part against which the tongue acts, and then twisted or spliced to the main strand.

For a robin or strap, the spring of a Brougham or other carriage, the wire strand is coiled round six or eight times in the shape and size required; it is then covered with leather, and stitched through between each strand. When used for the purpose of reins, a single strand is covered with leather, the buckle being attached as before described.

Instead of leather for the coverings of these strands, gutta percha, after being properly heated and cut into strips, may be used as aforesaid, the edges of which may be joined by heating and uniting them by pressure.

In the case where straps are used for driving machinery the patentee prefers using strands of copper wire; and for harness, iron wire, which may be either plaited, flat, or woven round.—*Patent Journal, No. 13.*

SHIPS BUILT ON THE WAVE SYSTEM.

Among the more important proceedings of the Mechanical

Section at the late meeting of the British Association, was the reading of the following paper :—

"On the Sailing Powers of two Yachts, built on the *Wave Principle*," by Dr. Phipps. The *first* was built for Dr. Corrigan, of Dublin, in 1844 : a small open boat, 24 feet by 6, of 3¾ tons, which did so well that she was able to beat everything near her own size, and to sail with those which exceeded it in some instances as far as four times. She was dry in seas where they were wet; was very stiff, sure in stays, and steered well at all times. The *second* is a yacht of 45 tons, O.M., for Samuel Hodder, Esq., of Ringabella, built from the drawing by Mr. Peasley, of Passage West, in Cork. She appears to have the following qualities:—A first-rate performance, attained without sacrifice of any good quality, large accommodation, high stability. She is weatherly, steady and easy, dry in the worst weather, and pitches and scends less than any vessel Dr. P. was ever in. She turns so sharply that no 10 ton yacht can do it quicker, and steers so well, scudding in a gale of wind, that, notwithstanding an unbalanced state, from an injudicious shift of mast, she neither broaches to nor is compelled to lay to, which a companion of larger size (60 tons), and of tried sea qualities, was forced to do; and, in consequence, arrived from Cork to Dublin 14 hours after the wave-built yacht. In a race at Kingstown for the Railway Cup of 100 guineas, in which she was matched against the best boats of the three countries in a time race, including one fine yacht of 100 tons, she won, and did the course exactly in 4h. 22m. 58s., it being 46 nautical miles. Making no allowance for tacking or starting from absolute rest, the rate of this is 10½ knots per hour. This is a great result for a principle yet in its infancy. The same vessel left Holyhead in a gale of wind, with storm-sails, main-sail stowed, and everything made snug; with a reefed try-sail, a double-reefed fore-sail, and third jib. She lay in one stretch to the Irish coast, where she tacked to the southward, beating down to the Arklow Light in 11 hours. Six persons on board, being separately questioned, agreed that the time from Holyhead to the Irish coast was 4½ hours. Making every reasonable allowance, less than 50 nautical miles could not have been done; and this gives a velocity of 11 nautical miles per hour,—an unrecorded speed for ships of any size close hauled, but surprising for a vessel of 45 tons, and in a very rough sea. It was, in fact, remarked on board that, as the wind freshened, her pace increased without limit. This agrees with the fact stated by Capt. Fishbourne, of the Flambeau steamer, on wave-lines, that she had a speed greatest in the worst weather, as compared with her rival. It is, perhaps, possible to improve sailing vessels greatly, as compared with steamers. When so improved, they might be used where sailing vessels nearly compete with steamers at present. This may be further helped by the diminution of insurance, and of the present unnecessary waste of human life."

Natural Philosophy.

TERRESTRIAL MAGNETISM.

LIEUT.-COL. SABINE has communicated to the Royal Society, the following "Contributions to Terrestrial Magnetism, No. VII."* From the discovery which was made of the non-coincidence of the locality of the maximum magnetic intensity within the Arctic circle with that in which the magnetic direction is vertical, it followed that the generally prevailing opinions respecting the distribution of magnetic force at the surface of the earth were erroneous, and that even the broad outline of the picture of terrestrial magnetism required to be recast. For the purpose of obtaining sufficiently copious and accurate materials by means of which so desirable an object could be accomplished, the British Association for the Advancement of Science requested in the year 1835 a Report to be prepared, in which the state of our knowledge, collected from a great variety of sources, with regard to the variations of the magnetic force at different parts of the earth's surface, should be reviewed and properly discussed, and suggestions offered as to the best means of extending the inquiry. In the Report so obtained, it was recommended that magnetic surveys of that portion of the North American continent which is comprised within certain isodynamic lines should be procured.

The present paper contains the results of an Expedition towards the accomplishment of this object, recommended by the President and Council of the Royal Society to be undertaken under the auspices and with the assistance of the Hudson's Bay Company. Lieut. Lefroy, of the Royal Artillery, who had received an appointment to the Toronto Observatory with a special view to this survey, was intrusted with the conduct of an expedition in conformity with that recommendation. The author gives a circumstantial narrative of the expedition, together with minute details of the instruments employed and the methods of observation adopted; and extensive tables of the observations themselves, both as regards intensity and inclination, at the different stations where they were made,—occupying altogether about 120 folio pages of manuscript. It results from the calculations founded on the table furnished by these observations, that the geographical position of the poimt of maximum intensity, where its amount is 1·88, is 52° 19·3 north lat. and 268° ·01 long. The angle which the major axis of the ellipse makes with the parallel of geographical latitude is 57° 49·5, and the values of the semi-axes of the ellipse of 1.875 are 290 and 110 geographical miles, respectively.

THE MAGNETIC CONDITION.

DR. SCORESBY has read to the British Association, a paper on a *new and superior* mode of developing the Magnetic Condition in *properly prepared* and hardened steel bars, by interposing a thin plate of

* *For the previous* Contribution to the Series, (vi.) see Year-book of Facts, 1845. page 126.

soft iron between the operating magnet and the bar of steel to be magnetized. He had at that time supposed it to be necessary to extend the thin plate of soft iron the entire length of the bars of steel to be magnetized; but he had since found this to be by no means the case, since, by laying any number of unmagnetized bars of steel in a long line, and passing along them a horse-shoe magnet with its poles connected with a thin polished plate of soft iron (he used common hoop iron), the ends being slightly bent upwards to cause it to pass more freely over the steel bars, and then turning them over and renewing the process on the other face, he found he could communicate to the bars the full charge which they were competent to receive. The Rev. Doctor exhibited this experiment; and, by simply passing a horse-shoe magnet thus armed with an interposed piece of sheet iron, once over each face of twelve previously unmagnetized bars of steel, he communicated to them so much power as that they sustained their own weight, when held up as a chain.

HYDRODYNAMICS.

At the late Meeting of the British Association, was presented a valuable "Report on Recent Researches in Hydrodynamics," by G. B. Stokes. This report was divided into the following heads:—1. General theories connected with the ordinary equations of fluid motion. 2. Theory of waves, including tides. 3. The discharge of gases through small orifices. 4. Theory of sound. 5. Simultaneous oscillations of fluids and solids. 6. Formation of the equations of motion, when the pressure is not supposed equal in all directions. The first head referred to investigations of a rather abstract nature. Under the second, the researches of Mr. Green, Prof. Kelland, and Mr. Airy, on the subject of waves, were particularly alluded to, and the accurate agreement of theory with the experiments of Mr. Scott Russell pointed out. The important investigations of Mr. Airy on the theory of the tides were also mentioned. Under the next head were mentioned some experiments of MM. Barré de Saint-Venant and Wantzel, by which an empirical formula was obtained for the velocity of discharge of air through a small orifice, when the discharge is produced by a considerable difference of pressure. The common formula does not apply to extreme cases. A memoir, by Mr. Green, on the reflexion and refraction of sound, was then alluded to,—a paper which is remarkable from its bearing on the physical theory of light. The investigations mentioned under the fifth head related principally to the motion of pendulums in resisting media. Mr. Green has solved the problem in the case of an oscillating ellipsoid. The last head contained a notice of the theories of MM. Navier, Poisson, and others, on the irregularity of pressure in different directions about the same point. This theory may be considered to be that of the internal friction of fluids.

At the close of the reading of this admirable report,* Dr. Whewell

* "*The able Report of Mr. Stokes is one of those which support the high character and mark the value of the British Association.* It brings up the

referred to it as carrying out one of the very prominent objects of the Association, and as one of the fruits of the advice which he had given in 1830. He then commented on several parts of the report, and pointed out the importance of keeping distinctly before the mind the essential difference between two kinds of waves, in one of which the motions of the particles of the fluid were the same from the top to the bottom; in the other, the motions of the particles, while all circular, or rather elliptical, diminished rapidly until at the bottom it became nothing. Of this latter kind a familiar illustration could be had by watching the waves which the wind produced as it swept over fields of standing corn or long grass. He then adverted to the formation of the double wave,—an example of which was afforded by the tides at Southampton; and which had been investigated by Mr. Scott Russell in the Forth, and by others at Ipswich. He then briefly reviewed the theoretical researches of Weber, Kelland, and Airy, on the subject of waves; and concluded by saying, that as waves of sound were reflected echoes, so he conceived they must suffer refraction, though the observing of this was attended with experimental difficulties; but that these waves were diffracted, he conceived no one could doubt who would attend to the varying sound of a cascade as you approached it round a bending course, it being at first hidden from sight by interposed rocks, banks, or other obstacles. The President (Sir John Herschel) agreed with Dr. Whewell, and not only did he conceive that sound could be reflected, refracted, and diffracted, but pointed out several cases, as in some of the phenomena of the tuning-fork, where something closely analogous, at all events, to polarization must take place.

The Rev. Dr. Robinson, after referring to the desirableness of a Report on the practical principles of Naval Architecture, observed:—A few of the points on which information was wanted were these:—The stability of the vessel to carry a sufficiency of canvas to obtain the necessary speed was an important consideration. This stability was to be obtained either by lengthening the vessel, or still more by increasing the breadth, or else by bulk. Each of these modes, however, bore with it a corresponding disadvantage, and some general theory of proportion was most desirable. The second point was to enable the vessel to move through the water with the least possible resistance. By increasing the stability of the vessel, they increased also the resistance; and that resistance was also considerably promoted if the vessel left a slough or vacant place in the water in its stern. The third great object was to increase the power of the vessel to sail against the resistance of the wind; as in sailing near the wind her tendency to drift sideways was much greater than in going a-head. On none of these points had they any accurate theoretical knowledge

science of Hydrodynamics to the present time, and will be, in the *transactions of 1846*, the starting point for future investigations. Few but members *know the great* worth of the contents of the yearly volumes; and hence, in *some measure*, the ignorance and mistaken views of the usefulness of the *association.*"—*Literary Gazette*, No. 1548.

whatever. The water-line, which was the line formed by the water on being first separated and then closing behind the vessel, was entirely unsettled; almost every ship-builder having some favourite theory of his own, without, however, being able to assign any reason for adopting it. Dr. Robinson then gave some particulars of the excellent sailing qualities of Dr. Corrigan's yacht;* but said that it was probable the wave principle on which she was built might hereafter be still further improved; at least there were some points on which he would like to cross-examine the inventor.

THE WAVE SYSTEM.

IMMEDIATELY after the above remarks by Dr. Robinson, Mr. Scott Russell proceeded to explain the theory of what was known as the Wave Principle in Ship-building. He was first induced to direct his attention to this subject when the canal companies proposed, some years ago, to establish swift boats that might compete with the mail coaches. On being applied to by them, his first attempt was to build one with a spheroidal bow, produced by the revolution of an ellipse, but the result was not as successful as was to be wished. The favourite shape of bow among seamen at the time was that called a duck's breast, but the effect was to raise a large wave in front of the vessel, which of course considerably retarded its velocity. He then directed his attention to the motion of the water itself. When a vessel passed through the water at a great velocity, a high wave was raised at the head, as high, in the old steamers, as four feet; this wave, on falling back, formed a hollow by its pressure immediately behind it, and the water was afterwards sent out with great force on both sides of the bow. All this was a costly and useless expenditure of force. He thought that, in removing the particles of water to allow the vessel to pass, it was necessary to expend the least force on the whole; and, therefore, the first impulse should be given gently. This force should increase to a certain point, and then decrease as gradually, leaving the particles to rest quietly at the greatest breadth. In endeavouring to ascertain the least resistance necessary to bring the particles of water out of a state of rest, he conceived that there ought to be a similarity between the motion of water and that of a pendulum revolving in a circle according to the curve of the vessel's size; and this led him to adopt the form known as the wave principle. This is different from a bow formed of two straight lines meeting at an acute angle, in being gently hollower than such a bow towards the cut-water, and a little rounder towards the greatest breadth.

The object to be attained was, he conceived, to remove the particles of water rapidly, and, at the same time, not to throw them farther aside than the breadth of the vessel amidships. That this object was effected by the wave principle, he ascertained in the following manner:— He got his model boat, 75 feet long, to be carried along by high-bred horses at a speed of 17 miles an hour, and made the head pass between two oranges floating on the water, and which he intended to represent

* See Mechanical Section, page 107 of present volume.

two particles of the water to be removed. The oranges merely touched the side of the vessel until they got amidships, and there remained: thus shewing that no greater force had been applied to them than was necessary to remove them out of the way of the vessel. Another phenomenon observed was, that, instead of the high wave at the bow, which sailors thought was a sign of a ship sailing well, or what they called carrying a bone in her teeth, the elevation and subsequent depression of the water were entirely got rid of. In their place, there was a gentle long elevation just under the shoulder of the vessel, where all sailors would like her to be supported. For the closing of the water at the stern, he at first thought it would be better to have the same shape behind; and this had the effect of bringing the oranges together again behind in an horizontal direction; but he found it did not answer at all: it occasioned too high a resistance, and had a multitude of bad qualities; he discovered, in fact, that the fuller she was behind, and the flatter she lay upon the surface of the water, the quicker she sailed; and that this should be the case, is clear, when it is considered that the water, returning to its level, is governed by an entirely different law from that by which it is first separated. The power which sends the water into the wake has nothing to do with that which displaces it before. It is forced upwards by the greatest pressure from below in vertical lines of the cycloidal family. A run fine below and full above was attained by many experiments, as the best for good steering and other qualities. This full water-line above should never exceed a full cycloid. The vertical lines, in which the water rises in the secondary wave, (which really replaces the displaced water,) may be cut off at any convenient height close to the stern. These two considerations united led him to the adoption of what is known as the wave principle. In the wave formation, the greatest breadth of the ship is not at the bows, or even amidships, but a great way aft, in the ratio of 3 to 2. In the shear plan, the bow of this form has one main cycloid, and all the other bow-lines are parts of cycloids. In this form, the particles ascend and descend without shock.

An interesting discussion followed. Mr. Vignolles asked if the Admiralty had got vessels built on this principle?—*and if not, why not?* Mr. Scott Russell replied, that he had been much more desirous for the adoption of the system in other ships than in the Admiralty, because he had been informed that the Admiralty did not like the introduction of scientific principles into ship-building, and preferred remaining as they were. He had, therefore, been averse to obtrude the subject on them. He might state, however, that the best informed men at the Admiralty were aware of the existence of the wave principle, and it was not improbable they might adopt it, although he could not say how soon, nor to what extent.

ON ATMOSPHERIC WAVES.

MR. W. R. BIRT, in introducing his Report to the British Association, noticed the steps he had taken during the autumn of 1845 for observing the great symmetrical wave of November. In accordance

with instructions, about thirty sets of observations had been made, the stations extending in one direction from the west of Ireland to Heligoland, and in the other from the Scilly Isles to the Orkneys. These observations Mr. Birt had subjected to a very careful comparison, especially those made at his own residence near London, with those which he made in the autumn of 1842 at Leicester Square. The result of this comparison was such as clearly to shew that there was a most striking coincidence between the barometric movements of October and November, 1845, and those of a portion of September, October, and November, 1842. So close did this coincidence appear to the author, that, during the period from October 1 to November 21, in 1845, the barometric movements of October 23 to 26 were the only oscillations that appeared to have no corresponding movements in 1842. It appeared that the Great Wave commenced in 1845, near midnight, between the 6th and 7th; that it culminated on the 14th, and terminated on the 21st. During the 10½ days previous to the setting in of the wave, the movements in 1842 and 1845 were almost identical. Mr. Birt observed, that in 1845 the greater wave, in all its essential features, was very distinctly marked; that it was completely separated from all the preceding barometric movements; and that the *individuality* that was thus given to it induced the strong belief that we have obtained the *type* of the barometric oscillations during the middle portion of Novembre.

This type he proposed to express in the following language:— "That during fourteen days in November, more or less equally disposed, about the middle of the month, the oscillations of the barometer exhibit a remarkably symmetrical character: that is to say, the fall succeeding the transit of the maximum, or highest reading, is, to a great extent, similar to the preceding rise. This rise and fall is not continuous or unbroken; in three out of four of the occasions on which it has been observed, it has been found to consist of *five* distinct elevations. The complete rise and fall has been termed the great symmetrical barometric wave of November, and, as such, has been considered to result from the transit of a large wave; but there is great reason to believe that, while it may be due to the transit of a normal wave of about fourteen days' amplitude, it also exhibits the transits of *five* secondary superposed waves. At the setting in of the great November wave, the barometer is generally *low*, sometimes below 29 inches. This depression is succeeded by *two* well-marked undulations, varying from one to two days in duration. The central undulation, which also forms the apex of the great wave, is of larger extent, occupying from three to five days. When this has passed, two smaller undulations, corresponding to those at the commencement of the wave, make their appearance, and at the close of the last the wave terminates."

Mr. Birt exhibited curves of observations that had been made during November at Dublin, from 1829 to 1845 inclusive, which he had received from Capt. Larcom, of the Royal Engineers. From these curves it appeared that the great wave had been observed at Dublin in twelve out of seventeen years; and that, with two excep-

tions, in eleven years of distinct and well-marked transits of the great wave, the epochs of the maxima were confined to five days near the *middle* of the month, namely, from the 12th to the 17th.

While exhibiting these curves, the author invited attention to a remarkable and apparently constant depression of the mercurial column which occurred about the 28th of November: it had been observed in fifteen out of the seventeen years' observations, and appeared to be unconnected with the great wave. The author then proceeded to notice the comparison he had instituted between the curves he had obtained from various stations, and exhibited curves from twelve stations in Ireland, England, and Heligoland. From a consideration of these curves, which were so arranged as to shew the departure from symmetry in certain directions, he argued that, while the posterior slope of a wave of considerable magnitude was passing off towards E.N.E., the front of another was approaching from the N.W., and that it was the interference of the two that produced the symmetrical arrangement of the curves. In that portion of the area covered by the advancing wave, the barometer rose, and in that covered by the receding wave, it fell; while in that in which the two waves interfered, the atmosphere, as regarded these waves, was quiescent, and the smaller secondary waves passed on uninfluenced by them. He also shewed that these lines of symmetry or interference varied in different years. In the year 1842, the line of greatest symmetry passed from Dublin through Brussels to Munich; in 1845 it appeared to be confined to the south of England.

Mr. Birt then noticed the arrangements of the aërial currents or winds as to distribution of pressure. He stated that the observations on the winds in November, 1842, clearly established Prof. Dove's theory of parallel and oppositely directed currents; and he shewed, by diagrams, that, if these currents are shifting ones, as the Professor suggests, as they pass over any tract of country in a direction transverse to those in which the wind was blowing in each, all the phenomena of an atmospheric wave would be produced. He remarked, that if there was only one set of these parallel currents passing over a line of country, then the examination of the phenomena of an atmospheric wave would be comparatively easy. The discussion of the observations had, however, shewn that there were two sets of parallel and oppositely directed currents at right angles to each other: one set from the N.E. and S.W., with a lateral motion from the N.W., and the other from N.W. and S.E., with a lateral motion from the S.W.; and also that, when these currents are referred to the wave, the N.E. and N.W. currents, in their respective systems, represent anterior slopes, with the direction of the aërial currents at right angles to the axis of translation directed towards the *left hand;* and the S.W. and S.E. currents represent posterior slopes, the direction of the aërial currents still at *right angles* to the axis of translation, but directed towards the *right hand.* The author considered that these rectangularly posited currents explained several phenomena, such as the barometric wind-rose,

or the gradual rise of the barometer with N.W., N. and N.E. winds, and its fall with S.E., S., and S.W. winds, the revolution of the vane in one uniform direction, &c.; and concluded his Report with pointing out several important desiderata that should be made the subjects of future inquiries.

GREAT CIRCLE SAILING.

The Great Circle system of Sailing has been generally laid aside during the last two centuries in favour of *Mercator's plan*, which, being founded on the rules for conducting plane trigonometry, enabled a seaman of very confined mathematical knowledge to make the necessary calculations, while the time occupied in solving questions referring to the rhumb course was considerably less than that consumed in calculating the elements of "great circle sailing:" the latter system has, upon these accounts, given place to the more simple but artificial method of Mercator.

In voyages between places distant more than twenty degrees of longitude, the disadvantage of Mercator's system becomes apparent by prolonging the voyage: and this evil increases with the distance in longitude to such an extent that the true angle of position of places separated by the Pacific differs from the Mercator's course by 50° or 60°,—thus introducing errors connected with shaping the course, if the wind is unfavourable during the voyage, calculated to prolong the passing one half more than would be necessary if all the courses were founded on the *true* or *great circle course*. The substitution of the true spherical angle for the rhomb course has, therefore, been considered a desideratum of the highest order.

This great object is now, however, fully attained by the invention of Mr. Towson, watchmaker, of Devonport, who has submitted the results of his labours to the Board of Admiralty; and it is believed that the plan will speedily be published from the "Hydrography Office," for the benefit of the nautical world.

The method is most simple, and requires scarcely a minute for taking out the *course*, *latitude*, and *distance* for each fifth degree of longitude, in the passage of the Pacific, on the arc of a great circle. The results are copied *seriatim* from a table by means of a graphic index and a pair of compasses,—an operation purely mechanical: thus, in a few seconds, problems are solved that, under the old plan, required hours of tedious application; in short, it may be called the *Mariners' Ready Reckoner.—Communicated to the Literary Gazette*, No. 1555.

PHENOMENA OF LIGHT.

Three papers, by Professor Powell, were read at the late Meeting of the British Association, of which the following abstracts are given in the *Literary Gazette*, No. 1548:—

On the bands formed by partial interception of the prismatic spectrum.—These bands, which have been the subject of so much *controversy, are formed* under certain conditions, indifferently, *whether the retarding plate* be applied at one end of the spectrum or

the other. Hence, the term polarity does not appear properly applicable. The existing theory requires that the intervals between the bands should *enlarge* as the aperture of the eye or telescope is *contracted*. But experimentally this is not the case. The author, however, found that with a contracted aperture, the bands are always far more vivid and distinct, while they enlarge only with an enlargement in the angular extent of the spectrum. On the whole, the subject seems still involved in some obscurity; though the undulatory investigation of it is founded upon the strict grounds of that theory, and involves no arbitrary suppositions of such a kind as can be termed "untenable," or "inadmissible," unless the whole theory be rejected.

Elliptic Polarisation has been observed in the reflection of light previously plane-polarised from various substances besides those of metals, to which the property was at first supposed to be confined. The author on former occasions enumerated many such cases in which he had observed it; to these he now added the instances of Prussian blue, and the remarkably *earthy* meteorite which fell at the Cape of Good Hope in 1839. A number of other cases have been investigated by Mr. Dale, of Balliol College, Oxford, which are wholly non-metallic, but all of *high refractive power*, which condition appears to be the essential distinction.

Dr. Lloyd investigated a theory grounded on the principle of undulations, according to which, when polarised light is reflected from a *thin plate* of any substance, it ought to become elliptically polarised. And, according to other received views, all elliptic polarisation implies the action of a thin superficial lamina of the substance. But in the cases now considered, there appear exceptions to both these conclusions. Many cases of thin films give no ellipticity, and there are many cases of ellipticity when nothing like thin films can be supposed. Of the former kind, the author instanced decomposed glass, of which one kind sometimes found, having a metallic lustre, gives elliptic polarisation,—another, equally indescent but without that lustre, gives none. Of the latter class are most of the substances observed by Mr. Dale, such as sulphur, realgar, &c., and particularly China ink, in which the author had originally found elliptic polarisation when rubbed in a film on a plate, but in which he has now found the same property when in the solid mass, though it is restricted to those specimens which are of the purest description.

On attempts to explain the Projection of a Star on the Moon.—The author adverted to the singular discrepancies between the statements of different observers with respect to the facts; it being well known that the same occultation has been seen differently in this respect by different observers, and different occultations by the same observer; and it has even been thought that the phenomenon might be seen or not, according as the eye was fixed on the star or the moon. Under these circumstances, any general explanation must be premature; yet a step may be gained which may eventually prove of use, if we assign an experimental result which can be regarded as of an analogous kind

Such a fact the author has observed by forming an artificial star by the sun's rays reflected from a small globule of mercury; and on completely eclipsing the image by a small opaque screen, and viewing it through a telescope at a considerable distance, a small patch of light was seen distinctly *upon* the screen. The author was led to this experiment in connexion with one of Newton's, related in the third book of the *Optics*, which has always presented some difficulty; but this the author has succeeded in reproducing in a different way, and which refers to a peculiar effect analogous to and connected with diffraction, yet distinct from it in the strict sense of the term.

NEW ANEMOMETER.

Dr. Banks has described to the British Association, a New Anemometer, of his construction. The instrument is worked by a vane supported on a hollow wooden shaft, about two inches diameter, whose upper end is supported by slight friction rollers, and the bottom rests on a fine steel pivot. Each of two levers holds a pencil, one for the direction of the wind working in a spiral of three turns, which, by a very simple contrivance, returns to its position, if the wind move round the compass with frequency. The other lever is acted upon by the force-board attached to the vane, and which, in its retirement from an increasing wind, raises a series of weights together with a disk upon which, by a roller, the lever rests. The instrument is about two feet and a half long by two feet high, exclusive of the vane, which is attached to a tin tube, of length according to circumstances.

NEW PROPERTY OF LIGHT.

Sir David Brewster has communicated to the British Association, a "Notice of a New Property of Light exhibited in the Action of Chrysammate of Potash upon Common and Polarized Light." The chrysammate of potash, which crystallizes in very small, flat rhombic plates, has the metallic lustre of gold, whence it derives its name of golden fluid. When the sun's light is transmitted through the rhombic plates, it has a reddish yellow colour, and is wholly polarized in one plane. When the crystals are pressed with the blade of a knife on a piece of glass, they can be spread out like an amalgam. The light transmitted through the thinnest films thus produced, consists of two oppositely polarized pencils,—the one of a bright carmine red and the other of a pale yellow colour. With thicker films, the two pencils approach to two equally bright carmine red pencils. It is to the reflected light, however, and its new properties, that Sir David wishes specially to direct attention. Common light, reflected at a perpendicular incidence from the surfaces of the crystals, or of the films, has the colour of virgin gold. It grows less and less yellow as the incidence increases, till it becomes of a pale bluish white colour at very *great incidences. The compound pencil, thus reflected and coloured, consists of two oppositely* polarized pencils,—one polarized in the *plane of reflexion, and of* a pale bluish white colour at all incidences;

the other polarized perpendicular to the plane of reflexion, and of a golden yellow colour at small incidences, passing successively into a deeper yellow, greenish yellow, green, greenish blue, blue, and light pink, as the angle of incidence increases. This very remarkable property, which Sir David has discovered also in some other crystals, is not caused by any film of oxide formed upon the natural surface of the crystal, nor is it the result of any change produced upon the surface by external causes. It is exhibited, under the usual modifications, if the surface of the chrysammate be in optical contact with fluids and with glass: and when the crystal is in the act of being dissolved, or when a fresh surface is exposed by mechanical means, the superficial action of the crystal upon light is in both cases the same. When the chrysammate is re-crystallized from an aqueous solution, it appears in tufts of prisms of a bright red colour, the golden reflexion being overpowered by the transmitted light; but when these tufts are spread into a film by pressure, the golden yellow colour reappears. When the crystals of chrysammate are heated with a spirit lamp, or above a gas burner, they explode with a flame and smoke like gunpowder; and, by continuing the heat, the residue melts and a crop of colourless amorphous crystals is left. Sir David found the same explosive property in the aloetinate of potash.

In the discussion which followed, the phenomenon was rather regarded by Dr. Whewell and Sir J. Herschel as a curious action of the chrysammate of potash, than any new property of light. To this, however, Sir D. Brewster has demurred, justifying the title of his paper. Sir J. Herschel observed :—Whether the title of the paper, however, exactly agreed with the observed facts or not, all must admit that these facts were most important, and deserving of serious attention. He was not acquainted with the substance, chrysammate of potash, but its properties, both optical and mechanical, seemed to be interesting. The plasticity which it seemed to exhibit in particular occurred to him as curious; and this reminded him of a somewhat analogous property lately discovered in the substance plumbago, or the black lead which pencils are made of. It is well known that that substance can only be obtained in any purity at Borrowdale, in Cumberland, and has lately been getting very scarce. Now, although the powder of plumbago is one of the best materials for preventing friction or the partial adhesion of other things, yet it has been lately found that the particles of the powder themselves are capable of being made to adhere into a mass; indeed, more compact and uniform in its texture than the best mineral plumbago, by simply enclosing it in a case, extracting the air from among the particles, and subjecting the mass to violent compression.

Mr. Schunck, (of Rochdale,) said that he had discovered the chrysammic acid, which was part of the composition of the salt of which Sir D. Brewster's paper treated. It was formed by the action of boiling nitric acid upon aloes, and was one of the last products of that action. The aloetic acid of the other salt spoken of by Sir David was the first product of that action. The chrysammate of potash was a

beautiful and curious salt; and although so plastic as to be readily moulded into thin plates, was yet so sparingly soluble as to require above 1,500 times its weight of water to dissolve it.—*Abridged from the Athenæum,* No. 987.

NEW EYE-PIECE AND OBJECT-GLASS.

MR. LAWSON has described to the British Association, a "New Dark Eye-piece, and a New Mode of Contracting the Aperture of the Object-Glasses of Telescopes." Mr. Lawson detailed the several failures which he had experienced while endeavouring to protect the eye from the violent action of the sun's light and heat. At length he succeeded, by prolonging the eye-tube beyond the glasses, and placing in the side of the prolongation a slit capable of admitting the coloured plate glasses to be introduced or withdrawn. By this position being assigned to them, he found that they answered the end required effectually; while they were themselves placed in a position where the concentration of the heat and light upon them could not, in the slightest degree, injure them. He described several spots which he had observed on the sun's disc last spring. His method of contracting the aperture was by an outer tube sliding on the eye-piece tube, something like the spray tube of a common telescope. This, by being drawn out into the tube, more or less, will stop off more or less of the cone of rays proceeding from the object-glass to the eye-piece.

NEW MULTIPLYING CONDENSER.

M. A. F. SVANBERG was led, by the process used by M. Pfaff, of Kiel, in his researches on the electricity of contact between metals and fluids, to construct this new instrument, which, by a single contact of zinc and copper, can be charged by manipulation, requiring only a minute of time, to an intensity sufficient to give a brilliant spark and strong shock. It consists of two ordinary condensers, whose plates are of copper; the two lower connected by a copper wire. They are prevented from touching by plates of glass cemented to them, and a little larger, for the sake of insulation. The lower plates are supported by insulating stems, and the upper have insulating handles.

THE LUNAR CORRECTOR.

THE credit of this invention, which is of considerable importance to all persons engaged in nautical pursuits and tactics, belongs to Captain Andrew Thompson, one of the most experienced and scientific officers in the mercantile navy of this country. It consists of an instrument, the principle of which depends upon the minute variation of small spherical triangles. The instrument is formed by the third part of a circle of brass, having an index similar to a sextant, on which is set the *apparent distance.* The index bar and left limb are graduated, and furnished with moveable slides for performing what is termed "*Laying off*" the *apparent* altitudes; one of the slides being graduated

also to a scale proportioned to the radius of the instrument, shows at the point of intersection a number of minutes and seconds, which is the correction required; and then, by the help of a brief table, or by working a rule-of-three sum, the true distance is at once obtained. The great advantage of this instrument is its simplicity, and the little time, which, by the use of it, is required to work a lunar observation; in fact, the time required scarcely exceeds that required to find the latitude by a meridian altitude of the sun. For those navigators who are less expert than their more scientific brethren, and less accustomed to the vigour of very accurate and perplexed calculations, this instrument is a great boon: it affords an unerring method of working problems and observations, and to the more experienced lunarian it is also a valuable acquisition, because it not only facilitates his labours, but serves as a test to prove their correctness. It is difficult to describe this invention by words only, or even by drawings; but it may be seen at Messrs. Spencers, No. 111, in the Minories.

THE MOON.

The following is the appearance of the Moon, as seen in the great telescope of Lord Rosse, and described by the Rev. Dr. Scoresby, of Bradford:—"It appeared like a globe of molten silver, and every object of the extent of a hundred yards was quite visible. Edifices, therefore, of the size of York Minster, or even of the ruins of Whitby Abbey, might be easily perceived if they had existed. But there was no appearance of anything of that nature; neither was there any indication of the existence of water or of an atmosphere. There was a vast number of extinct volcanoes, several miles in breadth; through one of them there was a line in continuance of one, about one hundred and fifty miles in length, which ran in a straight direction like a railway. The general appearance, however, was like one vast ruin of nature; and many of the pieces of rock, driven out of the volcanoes, appeared to be laid at various distances." The Doctor says he expects it will soon be possible to daguerréotype the image of the moon upon the speculum—which cannot be done at present, as the moon is not stationary; but a piece of mechanism is contemplated, to move the telescope to a certain distance, with a motion corresponding to the movement of the moon.

PROTECTION FROM LIGHTNING OF HOUSES WITH METALLIC ROOFS.

Professor Henry has made to the American Philosophical Society a communication relative to a simple method of Protecting from Lightning Buildings covered with Metallic Roofs.

On the principle of electrical induction, houses thus covered are evidently more liable to be struck than those furnished either with shingle or tile. Fortunately, however, they admit of very simple means of perfect protection. It is evident, from well established principles of electrical action, that if the outside of a house were encased entirely in a coating of metal, the most violent discharge which might fall upon it from the clouds would pass silently to the earth

without damaging the house, or endangering the inmates. It also is evident, that if the house were merely covered with a roof of metal, without projecting chimneys, and this were put in metallic connection with the ground, the building would be perfectly protected. To make a protection, therefore, of this kind, the Professor advises that the metallic roof be placed in connection with the ground, by means of the tin or copper gutters which serve to lead the water from the roof to the earth. For this purpose, it is sufficient to solder to the lower end of the gutter a riband of sheet copper, two or three inches wide, surrounding it with charcoal, and continuing it out from the house until it terminates in moist ground. The upper ends of these gutters are generally soldered to the roof; but if they are not in metallic contact, the two should be joined by a slip of sheet copper. The only part of the house unprotected by this arrangement will be the chimneys; and in order to secure these, it will only be necessary to erect a short rod against the chimney, soldered at its lower end to the metal of the roof, and extending sixteen or twenty inches above the top of the flue.

Considerable discussion in late years has taken place in reference to the transmission of electricity along a conductor; whether it passes through the whole capacity of the rod, or is principally confined to the surface. From a series of experiments presented to the American Philosophical Society by Professor Henry, on this subject, it appears that the electrical discharge passes, or tends to pass, principally at the surface; and, as an ordinary sized house is commonly furnished with from two to four perpendicular gutters, (generally two in front and two in the rear), the surface of these will be sufficient to conduct silently the most violent discharge which may fall from the clouds.

Professor Henry also stated, that he had lately examined a house struck by lightning, which exhibited some effects of an interesting kind. The lightning struck the top of the chimney, passed down the interior of the flue to a point opposite a mass of iron placed on the floor of the garret, where it pierced the chimney; thence it passed explosively, breaking the plaster, into a bedroom below, where it came in contact with a copper bell-wire, and passed along this horizontally and quietly for about six feet; thence it leaped explosively through the air a distance about ten feet, through a dormer window, breaking the sash, and scattering the fragments across the street. It was evidently attracted to this point by the upper end of a perpendicular gutter, which was near the window. It passed silently down the gutter, exhibiting scarcely any mark of its passage until it arrived at the termination, about a foot from the ground. Here, again, an explosion appears to have taken place, since the windows of the cellar were broken. A bed, in which a man was sleeping at the time, was situated against the wall, immediately under the bell-wire; and although his body was parallel to the wire, and not distant from it more than four feet, he was not only uninjured, but not sensibly affected. The size of the hole in the chimney, and the fact that the lightning

passed along the upper wire without melting it, shew that the discharge was a small one; yet the mechanical effects in breaking the plaster, and projecting the window frame across the street, were astonishingly great.

These effects the Professor attributes to a sudden repulsive energy, or expansive force developed in the air along the path of the discharge. Indeed, he conceives that most of the mechanical effects which are often witnessed in cases of buildings struck by lightning, may be referred to the same cause. In the case of a house struck within a few miles of Princeton, the discharge entered the chimney, burst open the flue, and passed along the *cockloft* to the other end of the house; and such was the explosive force in this confined space, that nearly the whole roof was blown off. This effect was, in all probability, due to the same cause which suddenly expands the air in the experiment with Kinnersly's electrical air-thermometer.

Dr. Patterson stated, that Mr. Jefferson was of the opinion that metal roofs protected buildings, not from being struck, but from the danger of the stroke. The contrary opinion is generally held; but Professor Henry's experiments shew that Mr. Jefferson was correct. Dr. P. saw the lightning strike a row of dormitories with metal roofs, at the University of Virginia. The flash was very severe, but produced no evil effect; the lightning had spread itself over the surface, and left its mark at each interruption of the conductor, but did no damage. It was said at the University that the Rotunda had been frequently struck without injury.—*Proceedings of the American Philosophical Society; quoted in Jameson's Journal*, No. 80.

METEORITES IN THE IMPERIAL MINERAL CABINET AT VIENNA.

THE Vienna cabinet of Meteorites contains two hundred and fifty-eight specimens; they are from ninety-four distinct meteorites, twenty-five of which are of meteoric iron. Their physical characters are fully described by M. Partsch, and much information is added with regard to their geographical history. A table exhibiting their commercial value, appended to the work, increases much its interest:

	Florins.
The value of the Elbogen meteorite (iron), weighing 141 Vienna pounds, is stated at ..	10,000
The Agram meteorite, weighing 70 pounds, at.	10,000
An Atacama specimen, „ 5 „ 5½ loth	506
Weston (Connecticut) meteoric stone, weighing 3 loth	15
Nashville (Tennessee), „ „ $1\frac{27}{32}$	20
Richmond (Virginia), „ „ $3\frac{7}{8}$	36

—*American Journal; Jameson's Journal*, No. 80.

SENSATION AT GREAT HEIGHTS.

DR. LE PILEUR has submitted to the Paris Academy of Sciences a paper on the Sensation experienced at Great Heights; which has been called by various medical writers the mal de montagne. De Saussure, Humboldt, Boussingault, and many other travellers, have related the sensations which they felt, and which, generally speaking,

were acceleration of the pulse, prostration of strength, loss of appetite, nausea, vomiting, and other symptoms similar to those of sea-sickness. Dr. Le Pileur, in giving an account of the ascent of Mont Blanc, which he accomplished with Messrs. Bravais and Martins, in August, 1844, confirms the description given by other persons of these sensations when at great heights above the level of the sea. The Doctor and his companions suffered most during the first hour after their arrival at the summit of the mountain. In the second hour, they felt better, and after that they suffered very little ; but they had no appetite during the whole of the time that they were at a height exceeding 4000 yards. The author distinguishes between the sensations created by the mere fatigue of ascension, and those which are caused by the atmosphere in elevated positions : the latter are the acceleration of the pulse, the loss of appetite, and sometimes somnolency.—*Athenæum*, No. 916.

USE OF THE BAROMETRIC THERMOMETER IN DETERMINING RELATIVE HEIGHTS.

Mr. J. R. Christie, in a paper on this subject, attempts, first, to show the theoretical foundation of the very simple law, pointed out by Professor Forbes, according to which the difference of the boiling temperature of water at two stations is connected with their difference of level; and next, to test the accuracy of this law by a comparison of results deduced from his own observations on the boiling-point of water at different stations among the Alps of Savoy, Piedmont, and Switzerland, with the heights of the same stations as determined by other observers and by different means; and thus to arrive at a just conclusion with respect to the value of the Barometric Thermometer as an instrument for determining differences of level.

The conclusion drawn from comparison in tables is, that the barometric thermometer is capable of affording highly accurate and satisfactory results, perhaps even more so than the common form of barometer, but that there is considerable uncertainty attached to its indications. This uncertainty, far from being wholly attributable to the imperfections of the instrument as a measure of the atmospheric pressure, might, the author thinks, arise from an extreme susceptibility to rapid changes in that pressure, which remain unindicated by the more sluggish barometer.

THE ANEMOMETER.

Professor Phillips has read to the British Association, a paper "On the Anemometer," in which he noticed a new principle as likely to be applicable for the production of instruments free from defects be found in those now in use. In the "Anemoscope," thus suggested, it was proposed to measure the velocity of air by the rapidity of evaporation and the cold produced thereby. When the bulb of the thermometer, covered with cotton wool, is immersed in water and exposed to the air, the evaporation is known to produce a given amount of diminution of temperature ; and when the thermometer is moved

through the air, the rapidity of evaporation is increased. In the trials made by Prof. Phillips, he first ascertained the amount of diminution by simple exposure,—and then raised the temperature by the heat of the hand to that of the air, and marked, by a second-watch, the rapidity of cooling when the hand was withdrawn. By repeating this process in tranquil air, and when the thermometer was in motion, he was enabled to ascertain the increased rates of cooling by various degrees of speed, and on the other hand to tell the amount of speed by the rapidity of cooling. He tested this instrument on the South-Western Railway; and when the carriages were at the velocity of thirty-six miles an hour, his new anemometer indicated correctly the amount of velocity on its being held at the distance of two feet from the carriage. He did not profess to have constructed a perfect instrument; but his object was to call attention to the principle on which he thought an accurate instrument for measuring the velocity of the wind might be constructed.

Dr. Whewell explained to the Section, that the other avocations which engrossed his attention had for some time prevented his endeavouring to correct the few slight defects which the practical working of the anemometer, to which Prof. Phillips had alluded, detected; in particular, the accurate determination of the constant which connected its indications with the actual velocity of the wind at every instant. He now the less regretted this; as his friend, Dr. Robinson, had constructed, and worked for some months, an anemometer, the connection of the motion of which with the velocity of the wind was less subject to vary, and was of easy determination. It consists of two or three arms, attached to a spindle, carrying at their extremities hollow hemispheres of tin or copper, with the hollows of the hemispheres all turned in the same direction. The force of the wind exerted on the concave surfaces being four times as great as that on the convex, the spindle is made to turn in the same direction, whatever way the wind blows. Attached to the spindle are the count wheels of a gasometer; and the velocity thus determined is exactly the one-third of that of the wind.

Professor Stevelly stated that Dr. Robinson's anemometer had been at work since last November; and that so trivial was the friction, when compared with the power of the engine, that its motion was quite perceptible in breezes which were too gentle to disturb the leaves on neighbouring poplar-trees. This removed the only defect which Dr. Whewell complained of, as creating a difficulty in determining the relation of the velocity in his anemometer to that of the wind. Dr. Stevelly regretted that the absence of Dr. Robinson in another section prevented him from detailing on this occasion the very satisfactory experiments by which he had determined the relation between the velocity of the wind and that of the instrument. This had been accomplished by comparative observations with Lind's anemometer, and other modes of determining the rapidity of the current, and then comparing them with his own. The experimental determination had been in almost absolute accordance with the determination of theory.

SELF-REGISTERING METEOROLOGICAL APPARATUS AT KEW.

MR. RONALDS, on presenting to the British Association, at their late Meeting, his third annual volume of "Observations and Experiments made at the Kew Observatory," described his experiments on the Photographic Self-registration of the electrometer, the barometer, the thermometer, and the declination magnetometer—explained his existing apparatus for these purposes—and exhibited the resulting photographs; but first briefly adverted to his previous proposals in 1840 and 1841, and experiments in 1844, relative to the subject. The principal characteristic of his improved system is a peculiar adaptation of the Lucernal Microscope. An instrument of this kind was employed in July 1845, to register the variations of Volta's *Atmospheric Electrometer.* The pair of straws were properly insulated, and suspended within the body of the microscope, and towards its object end. A condensing lens was placed at the end itself, and a good lamp stood beyond that. A strong light was, therefore, projected upon those sides of the straw which were turned towards the condensing lens, and the other sides were in deep shade. The light also impinged upon a little screen, fitted into the back of a case, about two feet long, fixed to the eye-end of the microscope, at right angles with it, and vertically. Through this screen was cut a narrow curved slit, whose chord was horizontal, and radius equal to the length of the straws. Between the electrometer and the screen, a combination of achromatic lenses, by Ross, was adjusted to produce a good chemical focus of the electrometer, at a distance as much beyond the external surface of the screen outwards, as the thickness of one of the plates of glass to be presently mentioned. In the long vertical case was suspended a frame, about half the length of the case, provided with a rabbet; into this two pieces of plate glass could be dropped, and these brought into close contact by means of six little bolts and nuts. The frame could be removed at pleasure from the line by which it was suspended; and the line, after passing through a small hole stopped with grease at the top of the long case, was attached to a pulley, about four inches in diameter, on the hour arbor of a clock.

Lastly, counterpoises, rollers, and springs, were used for insuring accurate sliding of the frame, &c. A piece of Mr. Collen's photographic paper was now placed between the two plates of glass in the moveable frame; the long case was closed so as to prevent the possibility of daylight entering it—the clock was started, and the time of starting noted. All that part of the paper which was made to pass over the slit in the screen, by the motion of the clock became now, therefore, *successively* opposed to a strong light; and was, consequently brought into a state which fitted it to receive a dark colour, on being again washed with the usual solution, *excepting* those small portions upon which dark images of the lower parts of the straws were *projected through the slit.* These parts, of course, retained the *light colour, and formed the* long curved lines or bands, whose distances from each other at any given part of the photograph, i. e. at

any given time, indicated the electric tension of that time. Sometimes, daylight was used instead of the light from a lamp; and in that case, during the process, some appearances of the sky were occasionally noted, by which it was evident that in serene weather, when the sun's light and heat varied, and the paper became consequently either more or less darkened, the electric tension, as shown in the photograph, varied also, increasing with the increase of light, &c. This fact has not, perhaps, been before observed, but as the darkening effect on the paper could not be always depended upon, separate notes were taken of the intensities of light, and the same results obtained.

At the suggestion of the Astronomer Royal, a *Distinguishing Electrometer* formed on the dry pile system, was afterwards employed, which exhibited in the photograph not only the tension, but the kind of electricity possessed by the electrometer at any given time. The *dry thermometer* was next tried. It was of the horizontal kind, had a flat bore, and its tube was introduced through the side of the microscope. The tube had a diaphragm of narrow aperture fixed upon it, and the slit in the screen at the eye-end of the microscope was now, of course, straight and horizontal. The image was a little magnified, and the breadth of the dark band or line in the photograph became the measure of temperature inversely at any given time.* The *barometer* employed was of the syphon kind. The microscope was turned in order to bring the long case and its sliding frame into a horizontal position. The clock was placed at one end, and a little weight, sufficient to keep the frame steady, was suspended by a line passing over a pulley at the other. The lower leg of the barometer was introduced through the now *bottom* of the microscope; it was provided with a similar kind of diaphragm to that on the thermometer, and of course the slit in the screen was now vertical. A light blackened pith ball rested on the surface of the mercury, and its image was slightly magnified: it will in future be much more so. The *declination magnet* was one of two feet. It was provided with a damper, and its mode of suspension was *essentially* similar to that of the Greenwich Declinometer. In order to adapt it for self-registration, a light conical brass tube, projecting six inches beyond its north end, was affixed to the lower side of the spur which carried it; and to the north end of that tube a small wire, called the index, was attached at right angles. This index descended through little slits in the bottoms of the two cases which inclosed the magnet, &c., and took the place of the electrometer described above in the Lucernal Microscope, which was placed below the cases, and was now required to be much longer than before, in order that the image and motion might be sufficiently magnified, yet a flat field retained. Every thing was fixed firmly. A great many photographs were obtained, and sent for inspection to Greenwich. Concerning some *term day impressions*,

* *In order to* convert this into the wet bulb hygrometer, nothing, of *course, is necessary* but the application of the usual cup of water and the *capillary threads.*

Mr. Glaisher, the Magnetical and Meteorological Superintendent of the Greenwich Observatory, says that "The beautiful agreement of those results with these at Greenwich is highly satisfactory." Mr. Ronalds stated that Mr. Collen's paper is found the best adapted for the purpose of any which he has tried.

Mr. Broun described a simple method of recording the excursions of the declination needle which he had adopted. He attached to its extremity a fine pointed wire, standing at right angles to the plane in which the axis of the needle traversed; a sheet of paper, with fine iron filings sifted over it, was carried along by clockwork over this pointer; the result was, that a line of particles of iron was removed from the path of the pointer. This line was afterwards fixed indelibly on the paper by immersing it in a solution of galls; for a dark ink stain was formed on all the rest of the paper; that line alone remaining white.—*Athenæum*, No. 987.

DOLLOND'S ATMOSPHERIC RECORDER.

It having appeared to be desirable, at the Meeting of the British Association in 1845, that a correct self-regulating apparatus should be constructed, by which the various changes of the atmosphere should be recorded upon paper in such manner that they might be referred to at a future period, and Mr. Dollond having invented an instrument which records the following eight variations, viz.—the barometer, the thermometer, the hygrometer, the electrometer, the pluviometer, the evaporator, the force board, the anemometer, and the time,—Mr. D. at the late Meeting explained the various qualities of the instrument, which has been found to answer the purpose for which it was intended, in every way, satisfactorily.

1st. The barometer is registered at every change which takes place in the weight of the atmosphere at every half hour, and may be traced from one point to the next without any difficulty. 2d. The thermometer registers the various changes from cold in the night or morning, to the greatest heat in the afternoon, continuously. 3d. The hygrometer has the power of showing the changes from dryness to extreme saturation of moisture, to every hundredth of the scale, and is extremely steady in action. 4th. The electrometer is acted upon by a conductor, and measures each flash of lightning which comes within the range of the conductor. 5th. The pluviometer registers each drop of rain which falls upon the surface of the receiver, and shows the continuation of the falling quantity for every inch in superficies until the inch is discharged, when it again commences for another inch, which repeats the same course. 6th. The evaporator is so constructed as to retain a quantity of water with the surface exposed, and so guarded that rain cannot enter into the vessel. The surface gradually evaporates, forming a diagonal line upon the paper until an inch is evaporated, when a discharge takes place, and another commences. 7th. The force or power of the wind acts upon a board, 1 foot square, which is *registered in pounds* and ounces avoirdupois, from 1 ounce to

30 pounds. 8th. The direction of the wind is shown in circles, which, immediately upon inspection, shows the direction of the course or change which has taken place: for instance, if it has passed through the south or the north, from east to west; and the point from which it started and that to which it returned. All these eight varieties have their scales about half an inch from the marking points, and can be very easily read or referred to. There are markers on each edge of the paper for time, which paper is carried forward by a clock.

Mr. Dollond gave an account of the storm as shewn by this instrument at Camberwell on the 1st of August, 1846, during his absence. The barometer changed from 30·03 to 29·82 in.; the thermometer from 69° to 98° during the day, or 24 hours. The hygrometer ranged from 39° to 80° of moisture. At 2 o'clock, the electrometer was affected by the lightning, and registered 15 discharges or flashes in one hour. At $3^h\ 23^m$ the rain commenced falling, and in two minutes the pluviometer discharged an inch, which had previously stood at 11·90 in. for several days. At $4^h\ 3^m$ another inch was registered; and at $5^h\ 25^m$ a third inch was marked upon the registering paper; and so tremendous was the fall of rain and hail, that at $5^h\ 35^m$ a fourth inch was marked upon the paper, making, on the whole, 3·12 inches in $2^h\ 17^m$. The force of the wind was equal to 1 lb. 4 oz., and the direction changed from east to west, through the south, at $3^h\ 20^m$. The probable cost of one of these instruments is about £150.—*Athenæum*, No. 987.

DENT'S NEW PORTABLE AZIMUTH COMPASS.

In 1845, Mr. Dent explained to the British Association at Cambridge, his improvement of the Compass, which consisted in his placing the magnetic needles and the card on an axis, instead of the usual mode of suspension; the point being higher than the centre of gravity, and subject, when on ship-board, to the law of pendulous bodies. Mr. Dent has also exhibited to the Association at Southampton his Azimuth Compass, which, by turning in azimuth 180°, effects the correction for collimation; and, by inverting the card (it being engraved on both sides), affords the means of determining the error of the zero on the card not coinciding with the magnetic meridian. As a surveying instrument, having the adjustments for collimation and meridian, it is certainly elevated in the scale of scientific instruments. Mr. Dent related its satisfactory behaviour, particularly on board vessels propelled by the screw, and shewed that the vertical vibration caused in the vessel by the motion of the screw was such as to cause all ordinary compasses to be of no use, arising principally from the centre of gravity not passing through the centre of motion by the quantity due for the correction arising from dip. Mr. Dent said, that all experiments with the old compasses on board her Majesty's yacht Fairy had failed, whilst his was found to be the only compass by which the yacht could be steered, and was now used on board in preference to all others; he was also of opinion that all vessels in which the screw

was used must be steered with a compass having its needle and card on an axis.

TEMPERATURE OF THE EARTH AND SEA.

MR. A. S. TAYLOR has read to the Royal Institution, a paper "On the Temperature of the Earth and Sea." Mr. Taylor's conclusions are: 1. That, at a certain depth below the surface of the earth, there is a source of heat which increases as we descend. 2. That this heat cannot be derived either from the sun or from chemical changes. 3. That this heat neither perceptibly affects climates or seasons, nor influences the temperature of the surface of the earth, nor of the depths of the ocean, nor of the atmosphere. 4. That the vicissitudes of climates and seasons are entirely referrible to solar influence. 5. That this influence, even at its maximum, does not penetrate below 1-400,000th of the earth's diameter. 6. That, although we have positive evidence that subterranean heat exists, we can neither measure its intensity, nor determine the exact ratio of its increase towards the centre of the earth. 7. That there is no evidence to show that the earth is gradually cooling from a high temperature.

PLAGUE.

A REPORT of a Committee of the Academy of Medicine, to inquire into the nature of the Plague, and composed of the following, viz. Messrs. Prus, Ferrus, Begin, Dubois, Adelon, Dupuis, Londe, Melier, Pariset, Royer-Collard, and Poiseuille, has been read to the Paris Academy of Sciences. The conclusions come to by the Committee are as follow:—1. The plague is endemic in Egypt, Syria, and Turkey. 2. The plague developes itself spontaneously, under the influence of local and atmospheric causes. 3. Civilisation can alone prevent the spontaneous development of the plague, either endemic or epidemic. 4. The plague frequently presents itself under the form of epidemic maladies. 5. The plague is propagated by the air, and not by contact: consequently, the plague is not contagious. 6. Clothing, merchandise, and other effects, do not transmit the plague by contact, and do not form foci of infection. 7. Persons suffering under the plague form the only foci of infection, and transmit it through the medium of the air. 8. The foci of infection on board ship are formed by the persons suffering under the plague. 9. The period at which the symptoms of the plague make their appearance after the infection has been communicated never exceeds eight days.—*Athenæum*, No. 961.

METEOROLOGICAL PHENOMENA AT LAUSANNE.

PROF. WARTMANN, at the late meeting of the British Association, observed:—"Although many attempts have been made of late to extend our knowledge of the Electrical Phenomena of the Atmosphere, it must be confessed that much remains to be done. The frequency of the flashes of lightning, according to the latitude and to the seasons, is a subject of inquiry, which has been recommended by M. Arago.

It would also be interesting to record the duration of thunderstorms, the number of flashes of each of the two classes which have appeared, the height and general appearance of the clouds, and the hygrometric state of the atmosphere. I shall take the liberty to point out some facts which I have had occasion to witness on the evening of the 1st of August last. After many hot days, clouds appeared on the south-west part of the horizon of Lausanne, and when over the town they began to be illuminated almost without interruption. I counted more than forty flashes in twenty-two minutes, two-fifths of which were of the first class, and all going eastward. A flash of such a white brilliancy that the eye could not bear it, but the appearance of which was perfectly definite, did not disappear suddenly, but left a phosphorescent trace of a dark red colour, like to the illusions of the dissolving views and the '*traînées* or trails of shooting stars, which I observed on the night of the 10th of August, 1838. Another flash of the first class appeared at the under-part of the clouds, and after a rather long course it vanished at the very edge of it: no thunder was heard. Two flashes were bicuspidated; three others were tricuspidated at some distance from their origin,—two of which appeared together, one over the other, in the same horizontal position. Are those flashes as scarce as it is generally believed? Are they produced by a particular state of humidity, which makes the state of the air better conductors on many given directions simultaneously than in others? This I am not able to decide; but I think that the quantity of rain which happens to fall during a thunderstorm has a great influence upon the falling of the electrical fluid. Indeed, in a recent instance, a thunderbolt fell in a low part of a vintage near Lausanne, burning all the stems on an area of more than eighty feet square, during a shower of the most tremendous character, and without being attracted by more elevated conductors which were at a short distance; and, on the contrary, two years ago, during a storm which was accompanied by no rain, the thunder fell on the spot, and burned by ricochets stems here and there upon a surface of more than four acres."

MAXIMUM HEAT IN ENGLAND.

At Lenham Lodge, near Maidstone, Kent, Dr. George Hunsley Fielding, F.R.S., registered:—On Sunday, the 7th of June, 1846, the thermometer in the shade rose to the extraordinary height of 94° Fahr., exceeding by one degree the heat of the 13th of July, 1808, which was considered to be the highest on record in this country.

ANIMAL TEMPERATURE.

Mr. Rigge, F.R.S., has communicated to the Royal Society, Experiments relative to Animal Temperature, showing that there must be some source of Animal Heat besides the combustion of the Carbon and the Hydrogen contained in the Food of Animals. The subject of these experiments was a labouring man in the employment of the author, living on his ordinary food, and working at his usual employment. A strict examination was instituted into the quantity and che-

mical constituents of the ingesta and egesta during ten days: at the end of which time he had gained one pound in weight. He infers from the results of this experiment, that the carbon and hydrogen contained in the food of animals, which enter into combination with the respired oxygen, forming carbonic acid and water, do not generate sufficient heat for the purposes of animal life; and that consequently there must be some other sources of heat in the animal economy, one of which he believes to be the secretion of carbon.

CHANGE OF COLOUR IN A NEGRO.

THERE has been read to the Royal Society, "An Account of the Desquamation and Change of Colour in a Negro of Upper Guinea, West Africa," by the Rev. H. S. Savage. The subject of this narrative, named Tahtoo Duari, is a member of the Grebo tribe,—the aboriginal inhabitants of Cape Palmas and its vicinity. His parents were members of the same tribe, and natives of the same region. The father was of a decidedly black complexion, while the mother was what is termed yellow;—the two extremes observable in the tribe, and between which there is found every variety of shade. In March 1844, when about twenty-five years of age, Tahtoo was attacked with a quotidian ague, having previously been in perfect health. The febrile symptoms subsided in the course of a week, but were followed by a general desquamation of the cuticle, leaving the subjacent skin of a dingy yellow hue. A month afterwards, the same process, preceded by a similar febrile attack, recurred; and was followed by a still greater whiteness of the newly-formed skin, resulting in the complete conversion of a negro to a white man, retaining the characteristic features and hair of an Ethiopian. This change was accompanied with great sensibility in the skin to the heat of the sun and of fire,—exposure to which readily excited irritation, and even inflammation: but the general health soon became completely re-established. In the course of three months subsequently to this change, numerous spots of a chestnut-brown colour made their appearance; first, on the wrists, then on the back of the arms, head, and neck, and successively on the other parts of the body,—forming by their extension dark patches of various sizes, which, being scattered over the whole surface, presented a singularly mottled appearance: and, as the black colour became predominant, the white portions of the skin seemed like patches of irregular shape formed in the natural negro skin. With the colour of the skin, that of the hair, which had also become white, has been gradually restored to its former black hue. During this process of return to the natural colour the health has been remarkably good.

CAUSE OF THE CIRCULATION OF THE BLOOD.

PROF. DRAPER, in an elaborate paper on this inquiry, attempts to establish—

First. The systemic circulation is due to the de-oxidation of arterial *blood.*

Secondly. The pulmonary circulation is due to the oxidation of *venous blood.*

And, in conclusion, he offers some explanatory remarks on the phenomena of the coagulation of the blood.

We quote a portion of the latter :—

The application of the principles here set forth furnishes a very felicitous explanation of a great number of effects which we witness, to some of which I may briefly refer. It is well known that after ordinary death, whilst the arteries are empty, the systemic veins and also the right cavities of the heart are full of venous blood. The reason is clear, although the ordinary theory, that the heart acts like a pumping machine, fails, as is well known, to explain it. As long as arterial blood is deoxidizing it will move to the venous side, a movement which must continue until the arteries are empty.

But it may be asked, why do not the right auricle and ventricle relieve the veins, and by their hydraulic action in the last moments of life push the accumulating blood through the pulmonary system? Again the reason is clear. Movement through the lungs cannot take place except when oxidation is going on. The systemic capillaries continuing their action long after the last breath is drawn, they make the blood accumulate in the veins, and from them there is no escape.

In the same way, in fainting, the blood leaving the arteries accumulates on the venous side, and as its flow is dependent on the push of the arterial blood entering the capillaries, so soon as no more enters no pressure is exerted on the venous trunks, and if a vein is opened there is no discharge, and under such circumstances hæmorrhages at once stop.

After ordinary death, although the systemic arteries are empty, the pulmonary artery is full. That this should be the case is indicated upon our principles, for the blood cannot pass from the terminal ramifications of the pulmonary artery into the veins except by being oxidized. Respiration having ceased oxidation cannot take place, the movement is checked, and the blood remains in the artery.

In a paroxysm of asthma the lungs become obstructed with mucous secretions, and the rapidity of oxidation is therefore interfered with. Under such circumstances the passage of the blood is retarded, as is shown by the great dilatation of the jugular veins.

Whatever therefore deranges the process of oxidation deranges the flow of the blood. In violent expirations, such as in coughing, the observations of Haller show that the blood moves tardily in the lungs, and in delicate persons its retardation is so complete that it regurgitates in the great veins.

In a violent and continuous explosion of laughter, the jugular veins become excessively distended; the right cavities of the heart having no power to push the venous blood through the pulmonary capillaries, and owing to the expulsion of air from the air-cells, the blood itself fails to effect the passage with its usual speed. In this instance it must again accumulate in the veins.

The various cases here cited depend on retarded oxidation. I might now consider the reverse of this, or where oxidation goes on too rapidly, as when protoxide of nitrogen is breathed. Owing to

the great solubility of this gas in serum, and its power of supporting combustion, we should expect to find it exert that control over the circulation which is well known to be one of its peculiarities. This paper has, however, extended to so great a length, that here I must stop, though I have made no allusion to the movements in the lymphatics or lacteals, or to the flow of sap in trees, or to the circulatory movements of the lower animals. These can all be explained upon the same principle: thus the descent of the sap follows as a necessary consequence of the decomposition of carbonic acid in the leaf. Nor have I said anything of the obvious control which certain classes of nerves have over the systemic oxidation. There are many facts which prove that the nervous system regulates this operation, and can either facilitate it or keep it in check. In this there is nothing extraordinary. A piece of amalgamated zinc exhibits no tendency to oxidize in acidulated water, but by the touch of silver or platina it is made to submit itself to the action of that medium. The act of blushing, and all local inflammations, show that changes in the relations of the nervous system control the oxidizing action of arterial blood; but to these things I propose to return on a future occasion. What is here stated is sufficient to illustrate the general principle to which I wish to draw attention, that *the chemical changes which are impressed on these circulating fluids are the true causes of their flow.—Philosophical Magazine*, No. 186.

PHYSIOLOGY OF THE HUMAN VOICE.

MR. J. BISHOP has communicated to the Royal Society the following paper :—

After premising a brief description of the system of organs which are subservient to the voice, the author proceeds to consider the several theories which have been devised to account for its various modifications. These theories have, for the most part, been founded on the laws which regulate the vibratory movements of stretched membranous surfaces; and the investigation of those laws has accordingly occupied the attention of many eminent mathematicians, such as Euler, Bernoulli, Riccati, Biot, Poisson, and Herschel; but it is a subject requiring the most profound analysis, and involving the resolution of problems of much greater complexity than the laws of the vibrations of either strings or bars. The assumptions which are necessary in order to bring the subject within the reach of analysis—namely, that the membrane is homogeneous in its substance, and of equal thickness and elasticity throughout its whole extent, are at variance with the actual conditions of the vocal organs, which are composed of tissues differing in thickness, density, and elasticity, and of which the tension is indeterminate; circumstances which present insuperable obstacles to the attainment of a mathematical theory of their vibrations.

The author, after giving a critical account of the experiments made by Biot, Willis, Müller, Cagniard la Tour, and De Kempelin, on the vibrations of membranous laminæ, examines the various actions of the

vocal organs during the production of the more simple tones; and considers more especially the office of the vocal ligaments, in regulating the pitch of the voice, which he considers as resulting from variations in their length and tension conjointly. By applying to the chordæ vocales the formulæ of vibrating cords, he traces the influence which is exerted on their movements by the mucous membranes; and finds that they obey, to a certain extent, the laws of vibrating strings.

The analogy between the action of the glottis and that of a reed is next examined, and an opinion expressed that the movements of the glottis in the vocalization of the sound partake of the nature of the reed, during the partial opening and shutting of the rima-glottidis.

The author next investigates the acoustic relations between the actions of the glottis and that of the vocal pipe, and the acoustic effects of flexible membranous tubes on a column of air vibrating within it, and finds that the structure of the trachea and of the soft parts above and below the larynx is adapted to vibrate synchronously with any note that may be formed in the larynx. The falsetto voice may be produced either by the partial closing of the glottis, or by a nodal division of the vocal chords; the pitch of the sound in the production of this peculiar modification of the voice being such that the column of air in the vocal tube is of the precise length requisite to vibrate in unison with the larynx. The inquiry is further extended to the sources of the various tones of the voice in singing, such as the *bass*, *tenor*, *contralto*, and *soprano*; together with their subdivisions of *barytone*, *mezzo-soprano*, and *soprano-sfogato*; and to the places which they occupy in the musical scale. Independently of the falsetto, the compass of the natural voice rarely exceeds two octaves; although in some cases, as in those of Malibran and Catalani, it may extend even beyond three. The voice in singing is modulated by the contraction or relaxation of the velum, uvula, and fauces. The author, lastly, adverts to the attemps that have, at various times, been made by the Abbé Mical, Faber, Kratzentein, De Kempelin, Willis, Wheatstone, and others, to imitate articulate sounds by mechanism.

Having thus examined the human voice as resulting from the vibration of membranous ligaments, in obedience, first, to the laws of musical strings; secondly, to those of reeded instruments; and, thirdly, to those of membranous pipes; he arrives at the conclusion that the vocal organs combine, in reality, the actions of each of these instruments, and exhibit in conjunction, the perfect type of every one of them.—*Philosophical Magazine*, No. 192.

INFUSORIA IN VOLCANIC ROCKS.

EHRENBERG has arrived at some remarkable results with regard to the prevalence of Infusoria in Volcanic Rocks. They are as follows:—

Numerous and widely extended observations have proved that there *is an ultimate* reciprocal relation between independent infusorial life *and the volcanic* phenomena exhibited upon the banks of the Rhine. *Volcanic crystals* of sodalite, leucite, and probably of augite, consist, in *part, of masses* of infusoria.

The volcanic island of Ascension, so destitute of life, animal and vegetable, and even of streams of water, and situated in mid ocean, presents an enormous mass of volcanic cinders, which consist almost wholly of organic matters, principally of fibres of plants, along with some *fresh-water* siliceous infusoria.

Although observation shows that, in all parts of the world, the infusoria prevalent in volcanic rocks are of *fresh-water* origin; still Patagonia affords *marine* deposits, constituting masses of great thickness.

The pyrobiolitic rocks in Patagonia constitute extensive beds, 800 feet thick, containing no carbonate of lime, and only here and there a little sulphate of lime.

The cinders which have been ejected by Pompeii are of fresh-water formation; and they are similar to those constituting the tufa of Hochsimmer, on the Rhine.

The bed containing the fossil Mastodon, on the La Plata, and that of the fossil bones at Monte Hermosa, and the hills in the plains of Bahia Blanca, are formations of fresh-water origin, mixed with some marine.—*American Journ. of Science; Jameson's Journal*, No. 83.

POWERS OF ELECTRO-MAGNETISM, STEAM, AND HORSES.

Dr. Scorsby and Mr. Joule have communicated to the *Philosophical Magazine*, No. 189, a paper of elaborate Experiments and Observations on the Mechanical Powers of Electro-Magnetism, Steam, and Horses. We have only room for the results.

"Upon the whole, we feel ourselves justified in fixing the maximum available duty of an electro-magnetic engine worked by Daniell's battery at 80lbs., raised one foot high for each grain of zinc consumed, or, in other words, at about half the theoretical maximum of duty." (De Botto states that 45lbs. of zinc consumed in a Grove's battery are sufficient to work a one-horse power electro-magnetic engine for 24 hours. The intensity of Daniell's battery being ⅓ths that of Grove, it follows that 15lbs of zinc would have been consumed had De Botto employed Daniell's battery,—a result not widely different from the above).

Dr. Scoresby and Mr. Joule consider their experiments fully to bear out the idea expressed by the former in his "Magnetical Investigations," that steel magnets on his construction may be employed in the stationary part of the electro-magnetic engine with much greater advantage than electro-magnets. "We have," say they, "adverted to the imperfect construction of the magnetic apparatus employed in the above experiments; had we employed one of equal weight, but constructed of thin plates of hardened steel, and furnished with armatures and batteries in proportion, we think it highly probable that a power equal to that of one horse might have been attained, the whole weight of the apparatus being considerably under half a ton."

Having thus determined the capabilities of electro-magnetism as a *first mover of machinery*, it will be interesting and instructive to compare *it with two other* sources of power, viz. steam and horses.

1. A grain of coal produces, by combustion, sufficient heat to raise the temperature of a lb. of water 1°·634 ; in other words, we may say that the *vis viva* developed by the combustion of a grain of coal is equal to raise a weight of 1335 lbs. to the height of one foot. Now the best Cornish steam-engines raise 143 lbs. per grain of coal; whence it appears that the steam-engine, in its most improved state, is not able to develope much more than $\frac{1}{10}$ of the *vis viva* due to the combustion of coal into useful power, the remaining $\frac{9}{10}$ being given off in the form of heat.

2. A horse, when its power is advantageously applied, is able to raise a weight of 24,000,000 lbs. to the height of one foot per day. In the same time (24 hours) he will consume 12 lbs. of hay and 12 lbs. of corn.* He is therefore able to raise 143 lbs. by the consumption of one grain of the mixed food. From our own experiments on the combustion of a mixture of hay and corn in oxygen gas, we find that each grain of food, consisting of equal parts of undried hay and corn, is able to give 0°·682 to a pound of water,—a quantity of heat equivalent to the raising of a weight of 557 lbs. to the height of a foot; whence it appears that one quarter of the whole amount of *vis viva* generated by the combustion of food in the animal frame is capable of being applied in producing a useful mechanical effect, the remaining three-quarters being required in order to keep up the animal heat, &c.

Prof. Magnus, of Berlin, has endeavoured to prove that the oxygen which an animal inspires does not combine chemically with the blood, but is merely *absorbed* by it. The blood thus charged with oxygen arrives in the capillary vessels, where the oxygen effects a chemical combination with *certain substances*, converting them into carbonic acid and water. The carbonic acid, instead of oxygen, is then absorbed by the blood, and thus reaches the lungs to be removed by contact with the atmosphere. Adopting this view, it becomes exceedingly probable that the *whole* of the *vis viva* due to the oxidation or combustion of the "certain substances" mentioned by Magnus is developed by the muscles. The muscles, by their motion, can communicate *vis viva* to external objects, and, by their friction within the body, can develope heat in various quantities according to circumstances, so as to maintain the animal at an uniform temperature. If these theoretic views be correct, they would lead to the interesting conclusion (which is the same as that announced by Matteucci from other considerations) that the animal frame, though destined to fulfil so many other ends, is, as an engine, more perfect in the œconomy of *vis viva* than the best of human contrivances.

* The experimenters have been kindly informed by Mr. J. V. Gibson, of Manchester, an eminent veterinary surgeon, that 14 lbs. of hay and 10 lbs. of corn is the average provender requisite to support a horse of average size, so as to enable him to work daily without any depreciation of his physical condition. They have, however, equalized the quantities of hay and corn, on account of the experiments on combustion having been made with a mixture containing equal portions.

ACTION OF LIGHT ON VEGETABLE JUICES.

We quote from the Proceedings of the Royal Society, the following paper "On the Action of the Rays of the Spectrum on Vegetable Juices:" being an extract from a letter by Mrs. M. Somerville to Sir John F. W. Herschel, Bart., dated Rome, September 20, 1845. Communicated by Sir John F. W. Herschel, Bart., F.R.S.

In the experiments of which the results are here recorded, the solar spectrum was condensed by a lens of flint glass of seven inches and a half focus, maintained in the same part of the screen by keeping a pin-hole or pencil-mark constantly at the corner of the red rays, which were sharply defined by being viewed through blue spectacles; and the apparatus was covered with black cloth, in order to exclude extraneous light. Thick white letter-paper, moistened with the liquid to be examined, was exposed wet to the spectrum, as it was found that the action of the coloured light was thus rendered more immediate and more intense than when the surface of the paper was dry.

The action of the spectrum at the junction of the lavender with the violet rays was found in some cases to be different from what it is with either of these colours separately, indicating a break in the continuity of action, and suggesting the idea of a secondary spectrum. In many instances, the yellow and green rays exert a powerful influence on vegetable substances,—an influence apparently unconnected with heat, for the darkening is generally least under the red rays and immediately below them, where the calorific rays are most abundant. The action, in a great number of cases, produces insulated spots in different parts of the spectrum, but more especially in the region of the rays of mean refrangibility, in which neither the calorific nor the chemical powers are the greatest. The point of maximum intensity is sometimes altered by the addition of acids, alkalies, or diluted alcohol; but altogether, as the author states, the action of the different parts of the spectrum seems to be very capricious, the changes of colour produced being exceedingly irregular and unaccountable.

MAGNETIC OBSERVATIONS MADE AT SIR T. M'BRISBANE'S OBSERVATORY, MAKERSTOUN.

These results have been reported to the British Association by Mr. J. A. Broun, who arranges his observations under three heads:—

I. *Magnetic Declination.*—The annual diminution of westerly declination at Makerstoun is 5·8′. When proportional parts of this have been added to the monthly means from January, 1844, till August, 1846, their whole range is only 2·1′: that is to say, the mean position of the magnetic needle for any month, freed from secular change, has not been above 2·1′ farther west than the mean position for any other month. Mr. Broun conceives that he has found the annual period of westerly declination to consist of a minimum at the *vernal, and of a maximum* at the autumnal equinox, the mean range *being under 1·2′. From* the observations for 1843, Mr. Broun has *concluded that there is* a maximum of westerly declination when the

sun and moon are in opposition, and a minimum when they are in conjunction; that there is a maximum of westerly declination when the moon has its greatest north, and also when it has its greatest south declination, minima occurring when it crosses the equator. In the diurnal period, the double maximum and minimum has been found to exhibit itself in each month of the year.

In the *Transactions* of the Royal Society of Edinburgh, Mr. Broun has given certain results relating to the horizontal and vertical components of the earth's magnetic force; but these results were obtained in scale divisions, corrected for temperature by his method. In order to deduce the varations of magnetic dip, and of the total magnetic force, from the variations of these components, it was necessary to determine the values of the scale divisions in known units. Mr. Broun had previously shewn the inapplicability of the method recommended by the Committee of Physics of the Royal Society of London for the balance magnetometers: he now described a method by which the value of the micrometer divisions may be satisfactorily determined. This method will be found in the Introduction to the Makerstoun Observations for 1843. He has applied the same method to the bifilar magnetometer, and has found that the value of the scale divisions obtained in the way recommended by the Committee of Physics is also inaccurate for this instrument. With the aid of the values obtained by the new method, the following results have been deduced:—

II. *Magnetic Dip.*—The dip is a minimum when the sun and moon are in conjunction, and a maximum when they are in opposition. In the mean diurnal period for the year

The principal	maximum	occurs at	10h. 10m. A.M.
„	minimum	„	5h. 40m. P.M.
A secondary	maximum	„	2h. 0m. A.M.
„	minimum	„	5h. 40m. A.M.

Makerstoun mean time being always used. These periods vary to some extent throughout the year; the principal minimum occurring at 6 A.M. in winter, the two minima being nearly equal at the equinoxes, and the diurnal curve being single in summer. Mr. Broun has found that there is a maximum of dip about 4½ hours before the moon's passage of the superior meridian, a minimum about half an hour after that passage, a secondary minimum about 3 hours after it, and a secondary maximum about 8 hours after it.

III. *Total Force of the Earth's Magnetism.*—A minimum occurs when the sun and moon are in opposition, equal maxima near the quadratures, and a secondary minimum at the time of conjunction. In the mean diurnal period for the year

The principal	maximum	occurs at	5h. 40m. P.M.
„	minimum	„	2h. 10m. A.M.
A secondary	maximum	„	7h. 10m. A.M.
„	minimum	„	10h. 10m. A.M.

The periods of maxima and minima shift about two hours in the course of the year, and in summer the principal minimum occurs at 10h. 30m. A.M. The variations of force, with reference to the moon's

hour angle, were found by Mr. Broun as follows:—The principal maximum occurs about two hours after the moon's passage of the inferior meridian, a secondary minimum about four hours before the passage of the superior meridian, a secondary maximum about one hour after the superior passage, and the principal minimum about 6½ hours after that passage.

Curves were exhibited illustrating these results, and also the diurnal motion of a magnetic needle freely suspended in the direction of the magnetic force: from the latter some curious results have been deduced, which will be found elsewhere. It will be enough to mention at present, that in the mean for the year, the motion from 6 A.M. till 6 P.M. is very trifling; between midnight and 6 A.M. the needle is almost stationary, nearly the whole motion occurring between 6 A.M. and 6 P.M. The north pole of the needle describes an ellipse whose major axis is at right angles to the magnetic meridian, but the direction of this axis varies throughout the year.

PERIODICITY OF MAGNETIC INFLUENCE.

DR. PAGE, of Columbian College, Worthington, observes:—

There are some extraordinary influences upon the needle, having a kind of Periodicity, which cannot yet be accounted for, or identified with any meteorological fluctuations. There are also regular changes, which have thus far been noticed during the day. In the morning the current is at its maximum. About 10 o'clock A.M. it declines, and gets to its minimum about half-past 2 P.M., when the needle begins to return, and arrives within four or five degrees of its maximum of deflection at 8 P.M. Whether this point observed at 8 A.M. is the real maximum is not known, as I have not been able to observe it in the night. The range of variation from morning to night is about ten degrees. I have not been able to notice any irregularity in these changes except as to the time. The irregular disturbances are very interesting, and may be identical with the magnetic storms of Gauss. Upon certain days they are hardly perceptible, though they never cease altogether. On some days they are violent, if I may be allowed the expression. The needle does not take a sudden start and return as when influenced by lightning, but moves gradually without oscillation to some fixed point, from which it will return sometimes in two minutes and sometimes in ten or fifteen minutes. An extended series of observations will be necessary before any deductions can be safely made. If the wires should be separated by a slight interval during a thunder storm, doubtless electrical sparks would be visible. During heavy storms, a flash of lightning twenty miles distant from the wires of Morse's telegraph will induce electricity in the wire sufficient to operate the magnets and work the telegraph, sometimes recording several signals. A flash of lightning in Baltimore, forty miles distant from this place, will operate the magnet at this end of the line.—*Silliman's Journal, Sept. 1846.*

Electrical Science.

MAGNETIZATION OF LIGHT.

In the *Year-book of Facts*, 1846, pp. 114-16, will be found an abstract of Dr. Faraday's important paper, "On the Magnetization of Light, and the Illumination of Magnetic Lines of Force." Upon this Dr. Faraday has communicated to the *Philosophical Magazine* the following Note:—

"The title of this paper has, I understand, led many to a misapprehension of its contents, and I therefore take the liberty of appending this explanatory note. Neither accepting nor rejecting the hypothesis of an æther, or the corpuscular, or any other view that may be entertained of the nature of light; and, as far as I can see, nothing being really known of a ray of light more than of a line of magnetic or electric force, or even of a line of gravitating force, except as it and they are manifest in and by substances; I believe that, in the experiments I describe in the paper, light has been magnetically affected, *i. e.* that that which is magnetic in the forces of matter has been affected, and in turn has affected that which is truly magnetic in the force of light: by the term magnetic I include here either of the peculiar exertions of the power of a magnet, whether it be that which is manifest in the magnetic or diamagnetic class of bodies. The phrase "illumination of the lines of magnetic force" has been understood to imply that I had rendered them luminous. This was not within my thought. I intended to express that the line of magnetic force was illuminated as the earth is illuminated by the sun, or the spider's web illuminated by the astronomer's lamp. Employing a ray of light, we can tell, by the eye, the direction of the magnetic lines through a body: and by the alteration of the ray and its optical effect on the eye, can see the course of the lines just as we can see the course of a thread of glass, or any other transparent substance, rendered visible by the light; and this was what I meant by *illumination*, as the paper fully explains.—December 15, 1845. M. F."

At the opening of the session of the Royal Institution, Dr. Faraday thus illustrated the great fact of his researches—*the rotation of a ray of light by magnetic force*. The well-known oxy-hydrogen light of Drummond supplied the ray. This light was so directed by an arrangement furnished by Mr. Darker, as to make distinctly visible, over the whole theatre, all the phenomena of circular polarization which were required to illustrate Prof. Faraday's newly-discovered principle. A beam of common light was shown to be separable into two distinct rays of polarized light; and the properties of these, and their relation to each other, were repeatedly demonstrated to the spectators. Such being the subject of his operations, Prof. Faraday next exhibited the nature and extent of the force employed to accomplish his results. That force is magnetism derived from an electro-magnet of immense size and power. The magnet used was a half link of the former East India moorings, surrounded by several coils of thick copper wire, and the source of electric power was Grove's battery, about twenty cells of which were employed on this night. To give an idea of the force of this electro-magnet, Prof. Faraday mentioned that once, while he was at work in the laboratory, an iron candlestick which happened to be standing on the table near its poles, instantly

flew to them, attracted with such violence as to displace or break everything in its way. The great experiment of the evening was then successfully tried. A prism of heavy glass was so adjusted between the poles of the magnet as to receive the oxy-hydrogen light after it had been polarized, and before it was depolarized by Nicholl's eye-piece. The following facts, demonstrating the magnetism of light, were then exhibited :—

1. As to the rotation of the ray.—A polarized ray, having been extinguished by the depolarizing plate, was instantaneously restored when the magnetic current was sent through the prism through which the ray was transmitted : and conversely, the polarized ray, when, by the common adjustments of the plate, it had been made visible, was extinguished by the force of the current.

2. As to the relations of this electro-magnetic power to other laws of polarized light.—The rotation having been established, it was shown, (*a*) that the direction of the rotation was absolutely dependent on that of the magnetic force. (*b*), That, while in common circular polarization, the ray of light always rotates in the same direction with regard to the observer (to whatever part of the medium his view may be directed), it is very different in the state of the ray induced by this new force. When brought under the influence of the magnetic current, polarized rays always rotate in a constant direction with respect, not to the observer, but to the plane of the magnetic curves.

Prof. Faraday concluded by throwing out some general notions as to the possible development of these researches in the line of future investigations. It did not seem impossible to him that the sun's rays might be found to originate the magnetic force of the earth, and the air and water of our planet might be proved to be the dia-magnetic media in which this condition of the force was eliminated.—*Athenæum*, No. 985.

NEW MAGNETIC ACTIONS, AND MAGNETIC CONDITION OF ALL MATTER.

DR. FARADAY has communicated to the Royal Society the Twentieth Series of his "Experimental Researches in Electricity." Section 26th. "On New Magnetic Actions; and on the Magnetic Condition of all Matter."

The following is the order in which the several divisions of the subject treated of in this section of the author's researches in electricity succeed one another :—1. Apparatus required. 2. Action of magnets on heavy glass. 3. Action of magnets on other substances acting magnetically on light. 4. Action of magnets on the metals generally. 5. Action of magnets on the magnetic metals and their compounds. 6. Action of magnets on air and gases. 7. General considerations.

In giving an account of the contents of this paper, (says the *Philosophical Magazine*), any attempt to follow the track of the author *in the precise order in which* he relates the consecutive steps of his

progress in this new path of discovery, would fail of accomplishing its object: for, by adhering to such a course, it would scarcely be possible to comprise within the requisite limits of an abstract the substance of a memoir extending, as the present one does, to so great a length, and of which so large a portion is occupied with minute and circumstantial details of experiments; or to succeed in conveying any clear idea of the extraordinary law of nature brought to light by the author, and of the important conclusions which he has deduced.

We quote the following abstract from *the Athenæum*, No. 953.

One of the simplest forms of experiment in which the operation of this newly-discovered law of magnetic action is manifested, is the following:—A bar of glass, composed of silicated borate of lead, two inches in length, and half an inch in width and in thickness, is suspended at its centre by a long thread, formed of several fibres of silk cocoon, so as to turn freely, by the slightest force, in a horizontal plane, and is secured from the agitation of currents of air by being inclosed in a glass jar. The two poles of a powerful electro-magnet are placed one on each side of the glass bar, so that the centre of the bar shall be in the line connecting the poles, which is the line of magnetic force. If, previous to the establishment of the magnetic action, the position of the bar be such that its axis is inclined to half a right angle to that line, then, on completing the circuit of the battery so as to bring the magnetic power into operation, the bar will turn so as to take a position at right angles to the same line; and, if disturbed, will return to that position. A bar of bismuth, substituted for the glass bar, exhibits the same phenomenon. but in a still more marked manner. It is well known that a bar of iron placed in the same circumstances takes a position coincident with the direction of the magnetic forces; and therefore at right angles with the position taken by the bar of bismuth subjected to the same influence. These two directions are termed by the author *axial* and *equatorial*; the former being that taken by the iron, the latter that taken by the bismuth.

Thus it appears that different bodies are acted upon by the magnetic forces in two different and opposite modes; and they may accordingly be arranged into two classes; the one, of which iron is the type, constituting those usually denominated *magnetics*; the other, of which bismuth may be taken as the type, obeying a contrary law, and therefore coming under the generic appellation of *diamagnetics*. The author has examined a vast variety of substances, both simple and compound, and in a solid, liquid, or gaseous form, with a view to ascertain their respective places and relative order with reference to this classification. As no gaseous body of any kind, or in any state of rarefaction or condensation, affords the slightest trace of being affected by magnetic forces, gases may be considered as occupying the neutral point in the *magnetic scale*, intermediate between magnetic and diamagnetic bodies.

The magnetic properties of compound bodies depend on those of

their elements; and the bodies are rendered either magnetic or diamagnetic according to the predominance of one or other of these conditions among their constituent parts.

In one respect, the diamagnetic action presents a remarkable contrast with the magnetic; and the difference is not merely one of degree, but of kind. The magnetism of iron and other magnetics is characterized by polarity; that of diamagnetics is devoid of any trace of polarity: the particles of two bodies of the latter class, when jointly under the influence of the magnetic forces, manifesting towards each other no action whatever, either of attraction or repulsion. It has long been known that the magnetism of iron is impaired by heat; and it has been generally believed that a certain degree of heat destroys it entirely. The author finds, however, that this opinion is not correct; for he shows that, by applying more powerful tests than those which had been formerly confided in, iron, nickel, and cobalt, however high their temperature may be raised, still retain a certain amount of magnetic power, of the same character as that which they ordinarily possess. From the different temperatures at which the magnetic metals appear to lose their peculiar power, it had formerly been surmised by the author that all the metals would probably be found to possess the same character of magnetism, if their temperature could be lowered sufficiently; but the results of the present investigation have convinced him that this not the case, for bismuth, tin, &c., are in a condition very different from that of heated iron, nickel, or cobalt.

The magnetic phenomena presented by copper and a few other metals are of a peculiar character, differing exceedingly from those exhibited by either iron or bismuth, in consequence of their being complicated with other agencies, arising from the gradual acquisition and loss of magnetic power by the iron core of the electro-magnet, the great conducting power of copper for electric currents, and its susceptibility of being acted upon by induced currents of magneto-electricity, as described by the author in the first and second series of these researches. The resulting phenomena are to all appearance exceedingly singular and anomalous, and would seem to be explicable only on the principles referred to by the author.

Pursuing his inductive inquiries with a view to discover the primary law of magnetic action from which the general phenomena result, the author noticed the modifications produced by different forms given to the bodies subjected to experiment. In order that these bodies may set either axially or equatorially, it is necessary that their section, with reference to the plane of revolution, be of an elongated shape: when in the form of a cube or sphere, they have no disposition to turn in any direction; but the whole mass, if magnetic, is attracted towards either magnetic pole; if diamagnetic, is repelled from them. Substances divided into minute fragments, or reduced to a fine powder, obey the same law as the aggregate masses, moving in lines, which may be termed *diamagnetic curves*, in contradistinction to the ordinary *magnetic curves*, which they everywhere intersect at right angles.

These movements may be beautifully seen by sprinkling bismuth in very fine powder on paper, and tapping on the paper while subjected to the action of a magnet.

The whole of these facts, when carefully considered, are resolvable, by induction, into the general and simple law, that while every particle of a magnetic body is attracted, every particle of a diamagnetic body is repelled, by either pole of a magnet. These forces continue to be exerted so long as the magnetic power is sustained, and immediately cease on the cessation of that power. Thus do these two modes of action stand in the same general antithetical relation to one another as the positive and negative conditions of electricity, the northern and southern polarities of ordinary magnetism, or the lines of electric and of magnetic force in magneto-electricity. Of these phenomena, the diamagnetic are the most important, from their extending largely, and in a new direction, that character of duality which the magnetic force was aleady known, in a certain degree, to possess. All matter, indeed, appears to be subject to the magnetic force as universally as it is to the gravitating, the electric, the cohesive, and the chemical forces. Small as the magnetic force appears to be in the limited field of our experiments, yet when estimated by its dynamic effects on masses of matter, it is found to be vastly more energetic than even the mighty power of gravitation, which binds together the whole universe: and there can be no doubt that it acts a most important part in nature, and conduces to some great purpose of utility to the system of the earth and of its inhabitants.

Towards the conclusion, the author enters on theoretical considerations suggested to him by the facts thus brought to light. An explanation of all the motions and other dynamic phenomena consequent on the action of magnets on diamagnetic bodies, might, he thinks, be offered on the supposition that magnetic induction causes in them a state the reverse of that which it produces in magnetic matter: that is, if a particle of each kind of matter were placed in the magnetic field, both would become magnetic, and each would have its axis parallel to the resultant of magnetic force passing through it; but the particle of magnetic matter would have its north and south poles opposite to, or facing, the contrary poles of, the inducing magnet; whereas, with the diamagnetic particles, the reverse would obtain; and hence there would result, in the one substance, approximation; in the other, recession. On Ampère's theory, this view would be equivalent to the supposition that, as currents are induced in iron and magnetics, parallel to those existing in the inducing magnet or battery wire, so, in bismuth and other diamagnetics, the currents induced are in the contrary direction. So far as experiment yet bears upon such a notion, the inductive effects on masses of magnetic and diamagnetic metals are the same.

Dr. Faraday observes, that the contents of the preceding Series (the *Nineteenth*) of these researches, were, he thinks, sufficient to justify *the statement* that a new magnetic condition (i. e. one new to our *knowledge*) had been impressed on matter by subjecting it to the

action of magnetic and electric forces, which new condition was made manifest by the powers of action which the matter had acquired over light. The phenomena now to be described are altogether different in their nature, and they prove not only a magnetic condition of the substances referred to unknown to us before, but also of many others, including a vast number of opake and metallic bodies; and, perhaps, all except the magnetic metals and their compounds; they also, through that condition, present us with the means of undertaking the correlation of magnetic phenomena, and, perhaps, the construction of a theory of general magnetic action founded on simple fundamental principles.

ELECTRICITY OF TENSION IN THE VOLTAIC BATTERY.

MR. GASSIOT has read to the British Association, the following paper:—In 1843, I communicated a paper to the Royal Society, in which I described some experiments made in order to test the relation of the electrical and chemical actions which take place before and after the completion of the voltaic circuit. Amongst the various voltaic arrangements I then used, was an extensive series of the combination which has been generally denominated the water battery, the metallic elements of which are copper and zinc, and the exciting liquid, rain-water. With 3520 pairs, a continued series of sparks is obtained; and, although three years have elapsed, the battery is at this time nearly as energetic in its action as at first, merely requiring to be refilled with water from time to time as it evaporates. This was the only arrangement of the Voltaic Battery by which I was then enabled to exalt the effects of tension, so as to obtain the electrical spark before contact of the terminals; although, with the assistance of an exceedingly delicate gold-leaf electroscope, I at that time elicited distinct signs of tension in a single cell of Grove's nitric acid battery, and subsequently in one of copper and zinc, charged with sulphuric acid; but in all the different series of experiments described in the paper to which I have referred, I invariably found that the higher the chemical affinities of the elements, the greater was the development of the effects of tension. For instance, to produce a certain extent of tension with the gas battery of Grove, when charged with oxygen and hydrogen, ten or twelve pairs of cells were required; with hydrogen and chlorine, six pairs; with chlorine in a single tube, and amalgamated zinc as the positive element, two pairs; and, while it took sixteen cells of my water battery to produce a given effect on the electroscope, ten of the same cells, when charged with dilute acid, produced the same effect in the same instrument. The static effects of a voltaic battery are very feebly developed, except when the battery is insulated; and the difficulties of insulation in an extended series are at all times great. In the battery excited by acid solutions, these difficulties are much increased, in consequence of the conducting power of the liquids; still, they are not insurmountable; and as, of all the batteries hitherto constructed, the nitric acid battery of Grove is composed of elements of the highest chemical affinity, I determined

on constructing one in which the effects of tension should be heightened to the extent of exhibiting the spark before the circuit was completed; this I hoped to accomplish without being compelled to extend the series to any extraordinary number, as I had done in the water battery previously described. For this purpose, I had 100 glass cells constructed, 3 inches deep, with stems 7 inches long; the zinc of each series was attached to a slip of platinum foil; each cell was carefully charged in the usual manner (but only half full) with strong nitric and dilute sulphuric acid; and great care was taken that the outside of each cell with the stem was perfectly dry. To the terminals of this battery I attached the copper plates of my micrometer-electrometer, described in a former paper of the *Philosophical Transactions*, 1840. On approximating the plates of this instrument to about $\frac{1}{1000}$ of an inch, a series of minute sparks took place, and in a few seconds the usual voltaic arc was produced. This arc could then be elongated to the extent of half an inch, in consequence of the particles of the copper having passed between the plates. If, in lieu of the copper plates, pieces of charcoal be similarly approximated to $\frac{2}{5000}$ of an inch, the arc is at once produced, instead of the sparks as from the discs; the loose particles of the carbon being more easily detached by the force of tension, and, consequently, at once producing the arc. I believe that this is the first instance in which a *true spark* has been obtained from so small a series of the voltaic battery.

NEW ELECTRO-MAGNETIC BATTERY.

M. Breguet has exhibited to the Paris Academy of Sciences, a new Electro magnetic Battery, intended for the line of electrical telegraph of the Paris and St. Germain Railroad. A prepared magnet of steel is fixed perpendicularly upon a strong board; above, and very near the poles, a rectangular plate of soft iron is fixed upon an axis, which bears a pinion commanded by a large copper wheel. Upon the plane are engraved the letters of the alphabet, and opposite each letter there is a hole. The axis of the wheel has a handle, to which is fixed a steel point capable of entering the holes of the wheel. The handle has a hinge, in order that it may be raised or lowered; and is free at the centre of the wheel, so that, when the point is out of a hole, the handle may turn in either sense to find the letter and transmit it. Very near the edge of the wheel is a lever, the small arm of which is above its centre of motion, with a larger one under, which serves to work a second lever: they are combined in such a way that a slight motion of the small arm of the first may describe an arc to the extremity of the large arm of the second. The upper arm of the first lever serves as the point of arrest of the handle, at the same time that the large arm of the other stops the movement of rotation. The apparatus is so contrived as to engage and disengage itself in the finding and transmission of the letters without any effort on the part of the person working the battery.

EVAPORATION OF WATER UNDER ELECTRICAL INSULATION.

MR. ROWLES suspended two similar capsules of eight and a half inches diameter by silk strings, over a stove that was heated daily. Into each vessel, eight and a half ounces of water were poured; one of the vessels communicated with the earth by a copper wire. At the end of twenty-four hours, 2 oz. 279 grs. had evaporated from the insulated capsule, and 3 oz. 144 grs. from the other, making a difference of 345 grs. in favour of the capsule in communication with the earth. The same result was obtained with the heat of the sun.—*Mechanics' Magazine*, No. 1188.

THE ELECTRIC FLUID.

MR. W. F. STEVENSON, in a communication to the Royal Society, denies the existence of two Electric Fluids, and maintains that all the phenomena are explicable on the hypothesis of a single fluid; which when present in a conducting body renders it positive, and in a non-conducting body, negative; but a body which is naturally a conductor, may, he asserts, be rendered otherwise, by changing its form.

NEW EXPERIMENT.

M. VAN BREDA, in a letter to M. Arago, recommends to his attention the following Experiment, as appearing to demonstrate the repulsion which exists between the particles of the metal conducting the current. It is as follows:—

"If we make the current of the battery of sixty elements pass through a platina, iron, copper, or any metallic wire, the metal at first reddens; then it melts, and after some instants this fused metallic wire, in which various movements are perceived, breaks at an undetermined place, and the ends formed by the rupture are projected far along the wire: and the wire is, after the experiment, terminated, at the spot where it has been broken by the force of the current, by two globules. This phenomenon is not accompanied by any evolution of light or any combustion. The wire neither gains nor loses in weight in this experiment; there is only the ordinary spark which appears at the moment when the repulsion produces its effect, and when the wire is divided into two fragments."

SULPHUR IN ELECTRICITY.

M. BOUSSINGAULT has communicated to the Paris Academy of Sciences, a paper on the much-disputed point of the presence of Sulphur in Electricity. It is generally stated that an odour of sulphur accompanies the electric fluid. This, however, has been positively denied by many natural philosophers. M. Boussingault concludes, from some experiments on metallic substances which had been exposed to the action of the electric fluid, that sulphur is always present in such cases; that it is not in the state of sulphureous acid, but of sulphydric acid.

ELECTRICITY OF THE TORPEDO.

M. Matteucci, in some new experiments in Electricity, states, that in the Torpedo, as in all electrical fishes, there are a large number of organs, each of which has the faculty of giving out electricity under nervous influence; and that the organ, without being physically analogous to any of the apparatus of the human system, is nevertheless a multiplicatory apparatus.

ELECTRO-PHYSIOLOGY.

Prof. Matteucci has submitted to the British Association, a *résumé* of his latest researches in Electro-Physiology. In the first place, he described the experiments which prove that the development of electricity in living animals is a phenomenon peculiar to all organic tissues, and principally to muscular fibres, and that it is a necessary consequence of the chemical processes of nutrition. Prof. M. sought to prove particularly that the development of electricity in the muscles can never produce electric currents, which circulate either in the muscular mass, or in the nerves. It is only by a particular arrangement of the experiment that we succeed in obtaining a muscular current. Further, all experiments contradict the opinion of an electrical current existing in the nerves. Prof. M. proved that the current said to be proper to the frog, is, on the contrary, a general phenomenon which exists in all the muscles which have tendinous extremities unequally distributed; that this current, supposed to be peculiar to the frog, is merely a particular instance of muscular current. In the second place, Prof. M. laid before the section his last researches on electrical fishes. He showed that the laws of the electrical shock of these animals are a necessary consequence of the development of electricity, which is produced in each cell of the electrical organ, under the influence of the nervous power. In the third place, Prof. M. showed the relation which exists between the electrical current and nervous power. He proved that muscular contraction is always produced by a phenomenon analogous to the electrical spark, and that the electrical current does but modify the nervous excitability. On these facts, Prof. M. establishes a simple theory of electro-physiological phenomena.

In the prosecution of his inquiries on the Physiological Action of Electric Currents, Prof. Matteucci found it necessary to employ an apparatus, which was expressly made for him by M. Bréguet, adapted to the delicate appreciation of the intensity of the force of the muscular contractions excited by those currents. By this means, he was enabled to institute an exact comparison between the contractions caused by the direct, and those by the reverse currents, both at the commencement and at the termination of their action. The following are the general conclusions he deduces from the experiments thus conducted :—

1. The passage of the electric current through a mixed nerve produces a variation in the excitability of the nerve, differing essentially

in degree, according to the direction of the current through the nerve. This excitability is weakened and ultimately destroyed; and this takes place more or less rapidly according as the direct current, that is, a current circulating through the nerve from the centre to the periphery, is more or less intense. On the other hand, by the passage of the current in the contrary direction, that is, from the periphery to the centre, or the inverse current, the excitability is preserved and increased.

2. The variations in the excitability of the nerve produced by the passage of the current, tend to disappear more or less rapidly on the current ceasing. If the nerve be taken from a living animal, or from one in which life is but just extinct, so that its excitability is very great, these variations last only as long as the current continues to circulate; while, if the nerve has already lost some of its excitability, they survive the cessation of the current by a period of from one to ten or fifteen seconds.

3. If the same current be made to act upon a mixed nerve, the contraction which occurs on the first moment of its introduction is very different according to its direction; the direct current always occasioning a stronger contraction than that produced by the inverse current.

ELECTRO-CULTURE OF FARM CROPS.

Mr. Sturgeon has obtained by Experiments, the following results:

Grass grown on a parallelogram of land, 55 yards long by 22 yards wide, enclosed by underground wires, was found to be much more abundant than in any other part of the field; especially in a plot "upwards of 50 yards long, whose breadth was within the wires, and nearly at right angles to the axis of the parallelogram." This plot of grass was principally on the western side of the wires, and extended but a very little way on the eastern side. The axis of the wire-enclosed parallelogram was in the magnetic meridian.

ELECTRO-CHEMICAL PROTECTION OF METALS.

Prof. Brande has read to the Royal Institution, the following paper, "On the Electro-Chemical Protection of Metals." The chief subject of Prof. Brande's communication was, the description and philosophical explanation of the protection given to iron by coating it with zinc. The researches of Sir H. Davy in the years 1824-25 were noticed, and the effects of sea-water on copper, simply immersed in that liquid, were contrasted with the protection afforded to it by a cemented plate of zinc or iron. It was then demonstrated that, whenever two metals, possessing unequal affinity for oxygen, are brought into metallic contact in any medium containing oxygen, an electrical current is produced: that this current passes from the more oxidizable to the less oxidizable metal, and that the latter is protected by the increased corrosion of the former. Thus, the interior of a copper stew-pan will not be affected by acids so long as any of its *tinning remains; while*, on the contrary, if what is called tin-plate (*i. e. iron plate coated* with tin) be scratched, however slightly, the

iron is quickly corroded, the cuticle of tin being protected at the expense of the metal which it was designed to preserve. Now, zinc on iron is what tin is on copper, a perfect protection, so long as any remains on its surface. It was then shown that, generally, the direction of an electric current depended, not only on the metals, but on the nature of the medium through which the current passed (*e. g.* on whether an acid, or a solution of sulphur, or of any other electro-negative substance, was used). Instances of metallic deposition by chemical affinity, as that of lead on zinc, of copper on iron, &c. were exhibited; and it was shown that, whenever the electric current was superinduced by the employment of a conductor of electricity, whether metallic or not, the metal passed to the conducting (or the electro-negative) surface (the cathode of Faraday). The process of zincing iron was then exhibited. The metal is carefully scoured, steeped in dilute acid, washed in water and thoroughly dried, and then plunged into melted zinc. As it is necessary that there should be perfect metallic contact between the metals, sal-ammoniac is sprinkled over the melted zinc before the immersion of the iron. This covers the liquid metal with a film of chloride of zinc, which precludes intervening oxide, and thus insures perfect adhesion between the coating and coated metals. Prof. Brande concluded his communication by exhibiting zinced iron piping, and by mentioning instances of the successful application of this invention, as in the cases of the iron roofing of the Houses of Parliament, the buoys used by the Trinity House, wires of galvanic telegraphs, &c. —*Athenæum*, No. 955.

INFLUENCE OF MAGNETISM ON MOLECULAR ARRANGEMENTS.

MR. R. HUNT, having been engaged some time since in investigating the influences of bodies on each other in the dark, the results of which investigations were published under the title of "Thermography," he then observed many peculiar effects which led him to believe that Magnetic Electricity had some influence in determining the arrangements of Molecules. From that time until January last, the subject rested without any further research. Having, however, put the subject to the test of experimental examination, Mr. Hunt has transmitted an account of his experiments to the *Philosophical Magazine*, No. 184. In doing this, he has confined himself strictly to a description of the arrangements used and the results obtained, reserving any theoretical views for some future period, when by a greater number and variety of experiments it appears probable some general law of action may be satisfactorily deduced.

These experiments Mr. Hunt considers sufficient to show that magnetism exerts a powerful influence on molecular arrangements, and that it regulates the direction of crystalline formations. He *hopes to* be enabled to pursue this interesting inquiry still further.

CONSTITUTION AND FORCES OF THE MOLECULES OF MATTER.

DR. LAMING has stated to the British Association, his theory of

the Constitution of Matter to be an assemblage of inductions—a system of causation springing from facts, and not the result of accident, or of a seeking for causes to explain preconceived notions. He considers matter to consist of three sorts of spherical atoms: basic (inert matter), calorific, and electric; and each molecule of matter to be constituted of a basic atom, surrounded by electric atoms, and each electric by calorific atoms. The number of electric atoms is invariable, but sometimes the "electrosphere" is made up by complementary atoms, which play an important part in the theory; for, without them, Dr. Laming conceives we should not be able to excite electrical action at all. Every phenomenon of electricity he attributes to attractions, denying the existence of what is termed repulsive force. In short, the theory demands an essential change in all our views in electricity, chemistry, &c. It has been the study of ten years, and the author appears fully convinced of its truth. His communication contained between forty and fifty propositions, with the corresponding facts of each,—a series of propositions affecting the constitution of the universe, embracing such a variety of subjects as rendered it impossible to collect the author's comprehensive views. In this, we are borne out by a confession, to the same effect, of Sir J. Herschel. But one striking result may afford an idea of the theory—namely, the ponderability of electricity. "Electricity (Dr. Laming asserts), is the only body that possesses weight." "Everything owes its weight to electricity." This he states he has experimentally proved, by communicating to a cylinder, nicely balanced and protected from foreign influence, different quantities of electricity. The cylinder with a plus-charge descends, or has a tendency to descend; with a minus-charge it ascends. The truth of this experiment, Dr. Laming said, was admitted by the Academy of Sciences, at Paris, seven years ago, but no report upon the subject was ever made.

The electricians present were sceptical; but an eminent one, Mr. Gassiot, said that if Dr. Laming could show by experiment that electricity possessed weight, he would at once and unhesitatingly adopt the new views. Dr. Laming said that he could; that the theory had suggested the experiment, and that the experiment proved the theory.

Sir John Herschel warned the Section against dependence upon a single experiment.

ELECTRO-MAGNETIC CHRONOSCOPE.

Prof. Faraday has described at the Royal Institution, Prof. Wheatstone's Electro-magnetic Chronoscope.

It is, (observed Dr. Faraday,) of great advantage to measure accurately intervals of time, as by astronomical clocks; but also smaller intervals, in the measuring of which our senses interfere. This interference was illustrated by knife-grinding; the sparks flying off *appearing to the eye* lines of fire: by the form of flame, *a glowing, dancing thing*; clouds of flame, flickering, waving, lambent;

without the impression of past events, a tongue of fire; and by the like retention of sensation on the retina, beautifully turned to account by Wheatstone, in the revolution of a disc divided into colours, seen altogether while revolving, and appearing white. Thus, then, are we cheated by our senses out of the true observations. And as proof, and to remove false impressions, the revolving wheel was exhibited to the audience under temporary lights; a flash of gunpowder partially resolving the white appearance into its elementary colours, and an electric spark, by its momentary existence, shewing the colours as though the wheel were at rest.

Dr. Faraday then referred to the rapidity with which electricity travels in copper, about 192,000 miles per second; and by an electric arrangement, at present, can we measure small intervals of time. And after mentioning an ingenious expedient to measure the velocity with which pistol-bullets travel, namely, two distant discs turned on the same axis, and shewing different positions of the holes, through both of which the bullet had passed; and after illustrating electric currents, and the measuring the time of a ball passing along a trough, itself making contact, and a bell ringing whilst the circuit was complete, indicating the duration of the passage, he proceeded to the true Chronoscope invented by Prof. Wheatstone. It consists of hands as indicators of a clock-movement, on the principle of the crutch escapement, to mark short intervals of time, and may be arranged for the 10,000th part of a second; their revolution being prevented by an electro-magnetic arrangement. The apparatus was adjusted, on this occasion, to measure the falling of bodies through a given space. A wire passed from the battery, over the top of a pole, to a plate moveable on it; from this a wire again went round a piece of soft iron near to a spring or keeper, thence to a rheostat, and thence to the battery again. The circuit was completed by the ball on the plate, at any height of the pole; and so long as the current was passing, the Chronoscope was at rest. At the foot of the pole, another circuit wanted only the weight of the ball to complete it. So that at the instant of the weight falling from the plate, the one circuit was broken and the hands of the Chronoscope revolved; and the moment it reached the bottom, the other circuit was made, and the hands stopped by the renewed current of electricity: the intervals moved over by the indicators could be then read off. Wires across pistols in connexion with the battery and Chronoscope, and others with the same and with the target, similarly exhibited the time of a bullet travelling over a given space.

Before concluding, Dr. Faraday took occasion to mention a thought of his in respect to the powers of matter. He had been led to speak of this by the inference drawn by Prof. Playfair at the previous meeting, that matter does not consist of particles, but of centres of power, as conceived by Prof. Faraday. The thought was, that radiant vibrations took place in the lines of force connecting the particles and masses of matter. He had talked of this as a fancy,

as a supposition, separating the undulatory theory from the ether, which is assumed by many. Is it not a strange thing that electricity should travel through conducting substances with the same velocity as light through this ether? What is the relation between them, or how to account for it? Light, he thought, might be vibrations along lines of force.—*Literary Gazette*, No. 1525.

ELECTRICAL FIGURES AND IMAGES.

M. RIESS has, according to *L'Institut*, classified the results of his investigation in this subject as follows:—

1. *Primary electrical designs.*—These are only visible on badly conducting surfaces, are produced by electricity acting on the particles of dust, and vary according to the kind of electricity. The dust-figures (Staubfiguren) appear under a broken, but not under a continuous discharge. They are consequently always formed by the species of electricity that is in excess; they are characterised in their different forms according to the kind of electricity, and, when a judicious choice of dust is made, by the manner in which this is spread, or by the colour. The dust-images (Staubbilder) come out, whatever be the species of electricity, and even by induction. By the latter, they are most frequently obtained, and are more beautiful. They are generally formed by the electricity opposite to that applied to the model. According to choice of dust, they are, in relation to different electricities, differently covered or coloured.

2. *Secondary electrical designs.*—These become visible only by a mechanical or chemical change in the surface of a plate acted upon by electrical discharges. They are developed on all sorts of plates, and by either electricity. They divide themselves into two groups—1st, In the case of their being rendered visible by condensation of vapours, the foreign layer on the plate being only affected. 2d, In the case of their becoming immediately visible, the surface of the plate itself being modified.—First, then, *Designs visible by the condensation of vapours.* They (Hauchfiguren, *figures of expiration*) result from a simple electrical discharge, and vary according to the substance of the plate upon which they are produced. On resin, they are in streaks; on metals, circular; on glass and mica, many times united. The *images of expiration* (Hauchbilder) result from discharges alternately opposed to each other, and do not vary with the nature of the plates, but a trifling difference in regard to being well or ill defined is due to the degree of their cleanness. Secondly, *Designs immediately visible.* Coloured bands, edged with two black lines strongly marked, are produced by a smart electrical discharge on the surfaces of mica and of soft glass. The coloured rings (of Priestley) proceed from the discharge between a point and a polished metallic surface. The images (Festenbilder) appear on all plates after a series of discharges alternately opposed; they continue for a long time after the complete *coming out of the image* of expiration. The electrolytic images *are produced on paper* that has been steeped in a liquid decomposable *by a series* of alternate contrary discharges, the half of

which only have effect, and in which a given electricity is discharged on the paper.

As one of the results of his researches, the author made known the remarkable property fresh mica possesses of condensing vapour of water, and hazarded an explanation of the varied forms of the dust-figure phenomena, hitherto enveloped in darkness.

Iridescent Silver.—(In a note from Professor John Brockelsby, of Trinity College, Hartford, Conn., to B. Silliman, jun.)

It is well known to those who are conversant with optical phenomena, that the brilliant play of prismatic colours exhibited by mother-of-pearl is due to the structure of the surface; provided the shell be cut and polished in a particular manner. This interesting fact was announced to the scientific world in 1829 by the discoverer, Dr. Brewster, who successfully transferred by pressure the splendid tints of the pearl to black wax, fusible metal, balsam of tolu, lead, tin, and various other substances. The colours displayed by fusible metal possess at first extraordinary beauty, which in a short time is partially lost, owing to a change that occurs upon the surface of the metal.

A few months ago, while engaged upon some experiments in electrotyping, I was led to think that by this process the hues of the pearl might be readily transferred to those metals which from their hardness are incapable of receiving impressions in mass; but yet, on account of their freedom from oxidation, retain for a long time a surface comparatively pure. I, therefore, took a Smee's battery, which I had just constructed, and after several experiments succeeded in obtaining small sheets of silver, radiant with the hues of the shell. When seen by a single light, as that of a lamp, the play of colours is surpassingly beautiful, scarcely inferior to that of the pearl; and where equal care was employed, the plate of silver, which was formed eight months ago, rivals in brilliancy that which came fresh from the battery a few hours since.

The process by which this result is obtained is as follows:—The first thing required is to prepare the shell. This is effected by grinding, and polishing it upon the back, in such a manner as to cut through the numerous concentric strata that compose its substance. When this is done, by the aid of a microscope the surface will be seen covered with delicate grooves, some thousand in an inch, formed by the sections of the concentric laminæ, and this configuration gives rise to the glowing tints of the shell. The next step is to obtain an exact impression of this surface upon some good conductor of electricity. This we are enabled to do by means of fusible metal, if proper precautions are employed in taking the impression. I pursue exactly the same method as in taking the copy of a medal. After fusing the metal, I pour it upon oiled paper, and when the air-bubbles cease to rise through the metal, the oxide is skimmed from its surface with a card; and as soon as it presents the appearance of a perfect mirror, the shell is forced down upon it by a sudden pressure. When the metal has cooled, I remove it from the shell; and having ascertained the accuracy

of the impression, immediately plunge it, before any change of the surface can occur, into the silver solution, thereby completing the circuit between the poles of the battery. In a few moments, the surface of the metal is frosted with silver, and the configuration of the shell exactly copied. A sheet of silver, of sufficient thickness to be easily removed with a pen-knife, will be deposited in the course of five or six hours under favourable circumstances. The battery I have employed consists of two plates of amalgamated zinc and one of platinized silver, 6 inches by 8. The working mixture is sulphuric acid and water, the strength varying with the temperature, and the amount of work to be performed. I have found a wine-glass of acid to three quarts of well-water, at the temperature acquired by standing a few hours in a room at 70° Fah. to answer very well, when the surface to be plated did not exceed 1½ square inches. The silver solution is made by dissolving cyanide of potassium in water, and adding thereto the oxide of silver. The ratio of the ingredients I am unable to state, as I have not hitherto directed my attention to this point, but have prepared the solution by trial until I obtained the desired result.

By the process above described, we can at pleasure transfer the tints of the pearl to those pure metals which will best preserve their brilliancy; and while the knowledge of this fact is interesting as a matter of science, it may perhaps be well for the artist to consider if it cannot be applied to some ornamental purpose, and the beauty of the precious metals enhanced, by teaching them to glow with the richest hues of light.—*Silliman's Journal; quoted in Jameson's Journal*, No. 80.

SPONTANEOUS SOUNDS IN IRON AND STONE.

SINGULARLY illustrative of the much disputed property affirmed by the ancients, of the Sound emitted at sunrise by the Statue of Memnon, in Lower Egypt, is the singular phenomenon of sound occasioned by the vibration of soft iron produced by a galvanic current. It was first discovered by Mr. Sage, and has been since verified by the observations of a French philosopher—M. Marian. The experiments were made on a bar of iron, which was fixed at the middle in a horizontal position, each half being enclosed in a large glass tube, around which were wound spirals of copper wire. A cord of copper wire was afterwards substituted for the two helices, and placed with its axis coincident with the axis of the bar. On completing the circuit, the longitudinal sound, although feeble, could be distinguished; the bar of iron being a little lengthened or expanded in the direction of its axis. The origin of the sound has therefore been attributed to a vibration in the interior of the iron bar, or a new arrangement of the molecules.

ELECTROTYPED CASTS FROM DAGUERREOTYPED PICTURES.

WE have now before us some beautiful Casts in copper from *Daguerréotypes, and impressions* from these casts, produced by Dr.

Paterson, of Glasgow, by means of the Electrotype. Smooth as the surface of a Daguerréotype would seem to be, a cast taken from it in the manner arranged by Dr. Paterson serves as a mould, from which almost any number of impressions may be taken. Dr. Paterson says, in a letter to a friend, "There is no limit to the number of impressions that may be taken, the last of a thousand being as perfect as the first; and, by taking a number of these moulds, numerous casts can be rapidly produced as bold and clear as the original type. There is very little difference in the appearance of the mould and of the cast; but in the cast, the lights of the picture being higher, like those of a woodcut, they catch the rays of light, and strike the eye with more force and clearness.

"As to the uses of these casts, independent of their great beauty they will put into the hands of artists the finest studies from the living figure, permanently fixing those almost momentary actions which the quickest pencil could not trace. They are well fitted also to hand to posterity, with faithful reality, the all but living pictures of eminent men; and they will, no doubt, be employed to preserve and multiply copies from many fine drawings before time has destroyed their beauty."

The most highly burnished parts of the casts present the deepest shade, and the brightest lights are the deepest cut, so that they probably will not serve to print from.—*The Builder*, No. 188.

GALVANO-PLASTICS.

We find the following in the *Athenæum*, No. 971:—

From Berlin, it is stated, that the Galvano-plastic process has been applied on a large scale at the establishment of the Baron de Hackewitz; a colossal plaster *fac-simile* of Ludovisi's Head of Juno, and a bust in plaster, modelled for the head by the sculptor Rauch, having been both covered with bronze. The scale may be estimated by our stating that the frontal region of the head in question is upwards of six feet in diameter, and nearly eighteen in circumference. The operation was performed in the presence of the King, and so successfully, that no after application of the chisel was necessary; whereupon the King gave orders for preparing for the same process a plaster cast of Thorwaldsen's colossal statue of Christ; and a model in wood of the gates destined for the church of the Royal Palace of Wittemberg, which are to bear in relief the text of the ninety-five Theses of Luther. The colour of the Baron de Hackewitz's bronze presents, when applied, shades of great beauty and variety, and it resists all the attacks of weather. The art of casting in metal is likely, therefore, to have a formidable rival in this new and economical process.

ELECTRICITY OF GUN-COTTON.

In the *Chemical Section* of the present volume, will be found *detailed this* discovery. Mr. J. E. Bowman, Demonstrator of Chemistry, *King's* College, states the "so-called Gun-cotton" to be

capable of being applied to a purpose different from any hitherto described, viz. that of insulating an electrically charged body. While engaged in unravelling some cotton which had matted together while in the acid, he was struck with the tenacity with which it adhered to his fingers; and, on lightly holding a small flock of it, and approaching a finger of the other hand, or any foreign body, found that it was strongly attracted towards it: thus differing essentially from the unprepared cotton. Mr. Bowman then subjected a little sewing cotton to the action of the acid, with the view of obtaining it in a more convenient form for testing its insulating power; and suspended from a brass rod two equally charged copper balls, one with white silk, and the other with the prepared cotton. By examining the two balls at short intervals of time, by means of a delicate gold-leaf electrometer, it was found that the one suspended by the cotton retained its charge considerably longer than the other: thus proving the cotton to be a more perfect insulator than the silk, which has hitherto been chosen as best adapted for the purpose of insulation.

The acid employed was a mixture of equal parts of nitric acid, sp. gr. 1·46, and sulphuric acid, sp. gr. 1·83, and the cotton was immersed for about five minutes. It was not highly explosive detonated only partially when struck with a hammer, and required to be heated considerably to cause it to explode.

To this, Mr. Richard Phillips appends the following note:—

In agreement with the above statement, I may mention that Mr. Reeks, of the Museum of Economic Geology, when drying some of the substance in question, and drawing it out, heard a crackling noise, which induced him to present it to the gold-leaf electrometer, when it instantly caused strong divergence of the leaves.

Philosophical Magazine, No. 195.

EXPERIMENTS WITH THE GYMNOTUS ELECTRICUS.

MM. de Miranda and G. M. Paci experimented with a Gymnotus at Naples, where it arrived from Rio Janeiro, Aug. 15, 1844. It was placed in a large metal trough filled with water: its food consisted of frogs and small fish. When it wished to eat a frog, it directed itself towards it, and when it reached the distance of about a foot, it stopped and looked at it. The latter became motionless, or, so to speak, paralyzed, when the gymnotus seized it, and fed upon it.

It is remarkable that the above effect is produced upon a single frog among all those that are swimming round the gymnotus; and it is not always upon the one that is nearest to it.

The gymnotus has been sometimes seen to act as Williamson describes it: namely, to kill frogs or fish as if with indifference, and without afterwards feeding upon them. This fact would seem to indicate that the only object which the animal has in view, in certain cases, is to discharge its electricity when it feels a need of doing so.

In cold weather, the gymnotus was removed into a wooden box, and a warmer apartment. It naturally lives in muddy water; the water in the trough and box were changed entirely but once a fortnight, and in the meantime warm water was added. By these precautions, the gymnotus,

which was originally from a warm climate, and accustomed to live in water at 26° cent. (80° Fahr.), passed a winter easily in a bath at the temperature of 22° to 24°, and in an atmosphere of 24° to 25°. It attained the length of 3 ft. 4 in. The largest gymnoti that Humboldt observed at Cano de Bera, in South America, were 5 ft. 3 in.

First, as to the phenomena of the shock. The shock is felt most powerfully when the animal is touched with both hands on two different parts of its body. In this case, it is felt in the arms and in the breast, which form an arc of communication; but it is also felt even when the animal is touched with a single hand: it is then felt in the arm that is in contact with the animal, and in the correspondent articulations; the discharge traverses the limbs, the ground, and the water of the bath. If a chain of several persons be formed, all feel the shock at the same time, whatever be the manner by which the discharge is obtained: namely, whether the first and the last person of the chain touch the animal at the same time, or one person alone places himself in contact with it. In the latter case, we have seen the shock communicated to four persons. Two persons having then touched the gymnotus, one towards the head, and the other towards the tail, one only felt the shock,—the one who touched the tail. At another time, it was the one who touched the head; again, at other times, both felt it, and more powerfully (as they fancied) than when either of them had alone felt it.

The gymnotus did not make the shock felt every time it was touched. Sometimes, it was necessary to irritate the animal, and even to squeeze it, especially near the electric organ,—a fact which proves, as Bancroft says, that its electromotive apparatus is not put in action except by the concurrence of its own will. Sometimes, when it has been irritated, the shocks that it gave were so energetic that they surpassed those of the strongest piles, and they who received them felt their effects for a considerable time; they really become painful when they are repeated; more or less energetic according to the degree of vigour and of the excitation of the animal; more intense before its meal than when it had eaten.

Two persons who were suffering with rheumatism, after receiving a few shocks from the gymnotus, were entirely restored.

Walsh, Ingenhouss, and Fahlberg, were the first to obtain the electric spark from the gymnotus, by interrupting the conducting circuit with two small gold leaves placed upon glass at the distance of a line from each other. MM. de Miranda and Paci, the present experimenters, obtained it in a much more brilliant and decisive manner. They employed a small bent glass tube, the two branches of which were equal, and which was filled with mercury in the bent part. They fixed at each extremity a long copper rheophore covered with silk, one of the ends of which descended into each tube as far as within a line of mercury. The opposite extremities of these wires were attached to two of those wooden handles, furnished with sponges, that are particularly employed in the medical experiments made with Clarke's large magneto-electrical apparatus. On exciting the gymnotus with the sponge upon the back and upon the abdomen, in points corresponding to the electrical organ, and operating in the dark, was seen the electric light burning on the surface of the mercury. On introducing into this circuit Henry's multiplying helix, the sparks were greater and more brilliant.

When interposed in the circuit a helix which had an unmagnetised steel needle in its interior, the needle was magnetised after a few discharges. This fact agrees with what Faraday observed in London upon the same fish in 1839, and which Professors Configliacchi, Barlocci, and Linari had previously observed in Italy with the ichthyo-chemical current of the torpedo. From the experiment made by Schœnbein and Faraday to decompose the iodide of potassium by the electricity of the gymnotus, the present experimenters endeavoured to place in communication with the above-mentioned rheophores Clarke's large apparatus for the decomposition of salts. They not only obtained the decomposition of the iodide of potassium, but that of nitrate of silver and acetate of lead. The two free extremities of the rheophores were terminated by platinum points; the latter were plunged into a porcelain capsule, containing the solution of nitrate of silver. The decomposition of the salt was not long in being brought about.

They in like manner produced with the gymnotus Nobili's uniform tints and Newton's coloured rings, which Linari obtained by the electric discharge of the torpedo.

Davy and Linari were the first to discover the calorific power of *ichthyo-electric currents;* the former by employing Harris's electrometer; the latter by employing Bréguet's thermometer. In the experiments made on the London gymnotus in 1839, Schœnbein attempted to discover the increase of temperature with Snow Harris's thermo-electric apparatus; but this apparatus having got out of order, he could not continue the experiment. However, Faraday thought that he perceived some indications of heat in the currents of the gymnotus. This induced the present experimenters to renew the experiment with Melloni's thermo-multiplier. They united a very thin silver wire by its two extremities to two conducting wires. The heat produced by the passage of the ichthyo-electric current was not sufficient to make the wire red-hot, but it heated sufficiently for the thermo-electric deviation of the galvanometer to be promptly manifested.

There were not obtained any phenomena of electric tension, neither with Singer's electroscope, nor with Bohnenberger's, nor yet with Perego's more recent instrument.

The same was not the case with galvanometric deviations; but there were verified on the Naples gymnotus the facts which had been observed by Schœnbein and Faraday; and on the torpedo by Blainville, Flourens, Barlocci, Linari, Matteucci, Zantedeschi, and Prudente. The present experimenters frequently obtained deviations of more than 90°, which could not be measured by the multiplying apparatus. The needle deviated briskly, as if it had received the impulse of a mechanical blow. The action was so intense as to alter the needle of the galvanometer, so as to render it unfit for other experiments. The same fact occurred to Linari, to Zantedeschi, and to Prudente, with the current of the torpedo. The present experimenters employed with advantage Majocchi's Universal Galvanometer; they in like manner had occasion to verify the phenomenon observed by Zantedeschi, namely, that it is not necessary to put the conductors into contact with the animal, but that it is enough to plunge them into the water, even at the distance of several inches from the gymnotus, to obtain a considerable deviation at the moment of discharge. The same result was also obtained with a closed circuit, by placing the hands upon the back and the belly of the gymnotus. Is this an effect of the great diffusion of electricity observed by Schilling, and then by Walsh, upon the gymnotus, and afterwards by Matteucci and Zantedeschi, upon the torpedo?

Since 1836, Linari obtained the most distinct phenomena of induction by the assistance of the electric discharge of the torpedo. The apparatus that he employed was nothing more than a system of two helices and three concentric galvanometer coils. The interior helix was electro-magnetic; the exterior was simply a spiral. The extremities of all the wires of which the helices and the galvanometers were formed were metallically united on the two sides of the helices and coils. They thus formed the extremities of a single wire in a helix, the thickness of which was equal to the sum of all the wires. Linari obtained galvanometric deviations, magnetization, and the induced spark, by means of this apparatus, which, as we see, was nothing else than a magneto-electro-dynamic spiral or a large solenoid. A similar arrangement with the gymnotus gave the same results: namely, an indication of the galvanometer and feeble magnetization of the needles.

They verified, by galvanometric deviations, and by chemical actions, a law discovered by Breschet and Becquerel, and confirmed by Matteucci, but which is opposed to the opinions of Davy and Walsh; namely, that all the points of the dorsal part of the organ are positive in respect to those of the abdominal part. They also verified the fact pointed out in London by Faraday and Schœnbein, that the head or anterior part is positive in respect to the tail or posterior part. Finally, they established on the gymnotus, Prudente's observation on the torpedo—that the electric currents are transmitted in the direction of the muscular fibres. This observation confirms that of Prevost—*that the electro-physiological current in the muscles is from above downward:* namely, from the head to the extremities.

These interesting results were communicated by MM. de Miranda and Paci to the Scientific Congress of Naples in 1845; they were next transmitted to the *Archiv. de l'Electricité*, Jan. 1846; and thence translated into Walker's *Electrical Magazine* for April.

Papers on the gymnotus and its economy, will be found in the *Year-book of Facts*, 1840, pp. 130-31 (with an engraving of the specimen at the Adelaide Gallery); another paper, p. 338: these three containing the researches of Faraday and Gassiot. See also the *Year-book of Facts*, 1842, p. 138, for further experiments with the same specimen; and the *Year-book*, 1843, p. 168, for results by other experimenters.

The gymnotus at the Adelaide Gallery died in March, 1842, after affording our *savans* many opportunities of experiments with its powers. An engraving of this gymnotus, with ample details of its habits, will be found in the *Literary World*, vol. iii. p. 34.

ELECTROLIZATION OF NEEDLES IN DIFFERENT MEDIA.

PROF. C. MATTEUCCI has communicated to the British Association, the following facts, which have especial interest with reference to the Molecular Polarisation of bodies, either interposed between two opposite electrical changes, or in presence of a discharge. As often as the armed interfoliate is formed of thin layers that may be separated the one from the other, we find that, after being charged, if we unmake this species of pile, each lamina, however thin it be, has upon its two faces opposite electrical charges: this phenomenon holds even when the layers are so strongly pressed together that they may be supposed to form a solid. This experiment succeeds with mica, sulphate of lime, glazed paper, &c. &c.

For the experiment in the case of discharge. Place needles of the same size and similarly arranged as in the researches of Savary, in presence of a platinum wire; pass a battery-discharge across the wire, and the magnetism taken by the needles will be found *to vary with the nature of the medium in which the needles were placed.* Prof. Matteucci used oil of tremanthine, olive oil, alcohol, and mica. The *maximum* of magnetism he found at very different distances from the wire, and this maximum varies according to circumstances. In air, for instance, the needle that takes its maximum of magnetism at 60 millimetres from the wire traversed by the discharge, receives it at 15 millimetres with mica interposed. The needles in the different media, the Professor added, were submitted to the same discharge, and at the same time. With the voltaic current the influence of the media increases a thousandfold.—*Literary Gazette*, No. 1552.

ELECTRICAL GIRL.

A GIRL, named Angélique Cotton, a native of the department of the *Finist re*, being suspected to possess certain marvellous qualities, was

sent to Paris: she was there taken to the Observatory, where Messrs. Arago, Mathieu, Laugier, and Goujon, witnessed the following experiments:—A piece of paper, placed upon the edge of a table, was immediately attracted by the left hand of the girl. She then, holding her apron in her hand, approached a guéridon, which was pushed back, although the apron scarcely touched it. The next experiment was to place her in a chair with her feet on the ground. The chair was projected with violence against the wall, while the girl was thrown the other way. This experiment was repeated several times, and with the same results. M. Arago laid his hand upon the chair to prevent its moving, but the force was too great for his resistance; and M. Goujon, having seated himself on a part of the chair, was thrown off as soon as Angélique had also taken her seat. Such, said M. Arago, were the facts witnessed, and he had seen nothing to justify an opinion that any deception had been practised. Subsequently, other experiments were performed by Dr. Tauchon, who had the chair in which Angélique was seated, held by two powerful men. In this instance, it was not driven away, but broke in their hands. A table, a guéridon, and a heavy sofa, were projected by the mere contact of the girl's clothes. Dr. Tauchon ascertained that the chair in which she sat was first attracted, and next repulsed. When Angélique was isolated from the ground by a glass stool, oiled silk, or any other non-conductor of electricity, the projections did not take place. A loadstone being placed near the left hand, which alone is magnetic, she experienced different sensations, according as the north and south poles were applied, and could tell with which pole she was in contact. She was repulsed by the north pole. She experienced violent commotions, when the electric discharges took place, and suffered greatly from them. It was in the evening, between seven and nine, about an hour after she had dined, that the electrical power was most strongly developed. Her pulse then beat from 105 to 120 per minute.

These results were *reported* to the Paris Academy of Sciences, on Feb. 16; a Committee was formed to investigate the matter; it included Becquerel, Isidore, Geoffroy St. Hilaire, Babinet, Lauglier, &c.; and, on Feb. 23, M. Arago declared as the result of their sitting, that none of the experiments made were successful—the young person not producing any of the effects that were announced!

"Electrical Ladies" appear to have an extraordinary fascination over philosophers; for, on referring to the *Year-book of Facts*, 1839, we find some extraordinary feats of one recorded to have been witnessed in the previous year, upon the authority of a physician, in *Silliman's Journal.* In the *Year-book*, 1840, we find similar freaks recorded of two girls, natives of Smyrna, who had exhibited themselves in Marseilles, and other towns of France. (See page 129).

GREENER AND STAITE'S PATENT ELECTRIC LAMP.

This invention is described by the Patentees as the means of *effecting the illumination* of public and private buildings, streets, *squares, and other public* places, by means of solid prisms or cylin-

ders of carbon, enclosed in air-tight vessels of glass or some other transparent substance, and ignited or rendered luminous by currents of voltaic or magnetic Electricity; such carbon being previously freed from the impurities with which it is ordinarily combined, and divided on the surface thereof into numerous acute points: or by means of rods or strips of platinum, or some other difficultly fusible metal enclosed in transparent air-tight vessels, and ignited or rendered luminous by currents of voltaic or magnetic Electricity as aforesaid, such metal being also divided on the surface thereof into numerous acute points: or by means of hollow cylinders of carbon, with surfaces either plain or acuminated, partially inserted within, and placed in perfect contact with hollow cones of platinum, either plain or acuminated. The whole is enclosed in transparent air-tight vessels as aforesaid, and the carbon is ignited or rendered luminous by voltaic or magnetic electricity, also as aforesaid. Or by a combination or combinations of the whole of the said means or methods, or of any two thereof, or of any of the parts thereof respectively. Both carbon and platinum have been before employed as media for the development and exhibition of electric light; but carbon, even in the purest states in which it has been hitherto obtainable when ignited, or rendered luminous in an air-tight glass vessel by means of electric currents, has been found to give out various extraneous matters which interfere with the continuity of the light, and, being precipitated on the inside of the glass vessel, obscure and darken the same; and plain surfaced platinum, when substituted for the carbon in the air-tight vessel, has never yielded more than a comparatively very feeble light.

The claims of the Patentees are :—*First*, the employment as a medium for the development and exhibition of electric light of carbon, purified and prepared as before described. *Second*, the employment for the said purpose of carbon and platinum, or any other like difficultly fusible metal in solid prisms, or cylinders, divided on the surface thereof into numerous acute points as before described. And, *third*, the employment for the said purpose of hollow cylinders of carbon, either plain or acuminated, in combination with hollow cones of platinum, or other like difficultly fusible metal, either plain or acuminated.

THE ELECTRICAL MAGNETIC BELL.

Dr. Wilson, F.R.S.E., has described to the Scottish Society of Arts, an application of the Electro-Magnetic Bell to the performance of experiments on the conduction of Sound. It is specially intended for ascertaining the conductivity for sound of gases, and as a substitute for the present somewhat inconvenient apparatus employed for that purpose.

In experimenting on the transmission of sound by elastic fluids, a bell-jar, emptied at the air-pump, and standing on its plate, is filled with the gas about to be tested. A bell contained within the jar is thereafter struck by a hammer, set in motion by clockwork, which in its turn is made to move by pushing a curved wire, passed air-tight

through a stuffing-box in the top, against a holdfast or ratchet, so as to unlock the spring-barrel, and permit it to set the machinery in motion. This clockwork is little within control of the experimenter, and cannot be made to vary in its rate of motion; so that although it is quite sufficient for class illustration, it is not convenient for the trial of varied experiments, and it is expensive. The electro-magnetic bell has all the advantages of the clockwork arrangement, is quite under control, and is not costly.

It consists of the ordinary electro-magnet; that is, of a horse-shoe of soft iron, surrounded by coils of covered copper wire, terminating in free extremities, which can be connected with the electrodes of a voltaic battery. The horse-shoe is fastened horizontally to a wooden stand, and between its limbs, near their exposed poles, a vertical rod is placed, supporting a time-piece bell. In front of the ends of the horse-shoe, a horizontal bar of soft iron is hung upon vertical pivots, so as to move through a small arc, towards or from the poles of the magnet; and to this bar or keeper a small hammer is attached, which strikes the bell, when the keeper is attracted to the magnet.

When the coil-wires are connected with a battery, the horse-shoe becomes a magnet, and pulls the keeper towards it, which carries with it the hammer and strikes it on the bell. When the battery connection is cut off, the keeper and hammer fall back; and by alternately connecting and disconnecting the wire proceeding to one pole of the battery, whilst the other remains in galvanic connection with the opposite electrode, the bell may be rung as often as required, and the strokes made to follow each other at whatever intervals of time are desired. This is the arrangement at present in use in our railway telegraphs, and is adopted without any modification in the apparatus before us, for the construction of which Dr. Wilson is indebted to the kindness of Mr. Bain.

In order that this electro-magnetic bell may be available for experiments on the gases, it is necessary to have the means of making and of breaking connection with the battery, whilst the bell arrangement is under a glass-jar on the air-pump plate. To secure this, the wires must be brought air-tight, and insulated through the sole of the pump, or through the sides or top of the bell-jar, so as to admit of their connection with the battery at a distance from the air-pump.

Dr. Wilson prefers that the wires, instead of passing through the sole or plate of the air-pump, be carried through the upper part of the bell-jar, which has a brass collar and top to admit of their passage, and is furnished with screws for the attachment of the battery wires. They are insulated, by being imbedded in ivory. Inside the bell-jar, the wires admit of connection with the ends of the electro-magnetic coils, by means of screws such as are employed in voltaic arrangements. In using this form of apparatus, after connecting the wires inside between the top of the bell-jar and the ends of the electro-magnetic coils, one of the battery wires is connected with one of the screws on the outside of the cap of the bell-jar; and with the other contact is made, by touching the head of the second screw, and

broken by withdrawing the wire. Whenever contact is made, the bell rings.

Should it seem desirable to make the bell ring itself, it could easily be done by placing one of Mr. Bain's electric clock pendulums between the battery and the bell. As that ingenious automatic instrument alternately cuts off and lets on (so to speak) the electric current, it would sound the bell at each stroke of the pendulum.—*Abridged from Jameson's Journal*, No. 80.

THE ELECTRIC TELEGRAPH.

The following are the leading novelties of the year, illustrating the progress of this newly-discovered application of Electricity:—

United States.—A communication has been read from Prof. Morse to the Paris Academy of Sciences, detailing the extent of the telegraphic lines already established in the United States of America. It is as follows:—

	Miles.
Albany to Buffalo	350
New York to Boston	220
Do. to Albany	150
Do. to Washington	230
Washington to Baltimore	40
Baltimore to Philadelphia	97
Philadelphia to New York	88
New York to Newhaven	84
Newhaven to Hartford	30
Hartford to Springfield	20
Springfield to Boston	98
Albany to Rochester	252
Total	1659

Prof. Morse states in his letter that the electric telegraph is now the chief mode of transmitting all the news of the Government; of the important correspondence of merchants, and of the public generally. Its influence has, he says, been already felt by the press. The journals of the large towns, which were taken in the country, on account of their giving the most recent news, have lost a great number of their subscribers, whilst there has been a very large increase in the circulation of the journals of the small towns near the extreme points of the electric telegraphs.

It is stated in a Philadelphia journal of June last, that Prof. Morse has added to his telegraph machinery, by which he can print at least 120 characters per minute. At the same time, he allows this invention to be due to European electricians, and states the rate of communication by each system to stand thus:—

Prof. Morse's (American)	100 per minute.
Bain's (Scotch)	50 „
Wheatstone's (English)	30 „
Breguet's (French)	12 „

The only telegraph in Europe which prints is said to be that of *Mr. Bain*, of Edinburgh, which, therefore, has this advantage, in common with Professor Morse,—that, while other telegraphs shew

the letter but momentarily on a little revolving dial plate, so that it is lost if not observed at the instant, those of Morse and Bain record them not only permanently, but with greater rapidity; especially that of Morse, by which, even with one wire, and upwards of a year since, sixty signs, it is said, were recorded in a minute.

Another American journal states that, so long ago as 1842, Prof. Morse could communicate at intermediate places along the line without interrupting the line of communication; and that, in the above year, he shewed thirty instruments to be operated along a line at the same time.

Effects of Lightning.—A very extraordinary phenomenon has been observed on the line of the electric telegraph between New York and Baltimore. Three thunder-storms, each some thirty or sixty miles from the other, were all coming east on the telegraph route about the same time, and every discharge of electricity from either was duly recorded *by the lightning itself* in the telegraph office at Jersey city, Philadelphia, Wilmington, or Baltimore. The wires became altogether unmanageable; and, the operators being obliged to withdraw the batteries used for writing, lightning, in effect, had the field to itself. The letters of Morse's telegraphic alphabet which this natural lightning seemed to be most partial to, were L and T; but occasionally it went at the numerals, and dashed off 1's, 50's, 55's, 500's, and 5,000's, in its own rapid style. We learn that, when two or more thunder-clouds get in the same vicinity, and discharge their electricity at each other, or receive the fluid from the earth and return it again, or when ground lightning prevails, the effect on the telegraph wires is to produce a strange and original language, which may yet be made intelligible.—*New York Paper.*

France.—The extent of the lines of electric telegraph in France is very small, compared with the account given by Mr. Morse; and very slow progress has been made by the Government Committee on Telegraphs, at the head of which is M. Arago. This Committee is to report on the various systems of telegraphic communication, particularly those of Mr. Morse, and Mr. Bain, of Edinburgh, which have been submitted to it.

Coating for Telegraph-wires.—The wires of the electric telegraph connected with the Munich and Augsburg Railroad have been covered with a coating invented by Professor Steinheil, of Munich, which possesses the virtue of protecting them from lightning, thereby greatly tending to prevent accidents.—*Galignani.*

Electrophonic Telegraph.—The journals of St. Petersburgh speak of an Electrophonic Telegraph, the invention of the Chevalier Lasckott, which Professor Jacob has presented to the Imperial Academy of that city. It is composed of a clavier of ten keys, ten bells of different sizes, and ten conducting wires, through whose means the letters of *the alphabet, and the* words which they form, are expressed by sounds *and harmonies.*

MR. BAIN'S ELECTRIC TELEGRAPH AND CLOCK.

Dr. J. Murray, in the *Mining Journal*, bears the following testimony to the completeness of Mr. Bain's inventions:—"His Electric Telegraph and Clock delighted me; as well as his Marine Log for determining a ship's rate of sailing, and accurately itself regulating that rate in knots and their fractions. The electric telegraph of Mr. Bain recommends itself for universal adoption, by its extreme simplicity, for railroads. Instead of multiplied lines, there is only in his ONE line; and, in the simple arrangement of the symbols and sentences, together with the equally simple manipulation, there seems to me to be left nothing to be wished for. Its operation on the Glasgow and Edinburgh Railway is every way, I was informed, satisfactory, and realizing all that could be desired. Mr. Bain's electric clock, however, is the great source of attraction. Nothing can be more satisfactory or complete; allowing for tear and wear of materials from friction and the oxidating influence of the atmosphere, the *perpetuum mobile* is here certainly realised. As long as the electricity of the earth continues, or, in other words, as long as the laws of nature last, so long will Mr. Bain's clock continue its oscillations, and register the transit of time. It requires no prophet to foretel their entire ultimate adoption for public clocks; and how singular and interesting the reflection that, by means of wires, connecting the various public clocks of the metropolis with the main one, the pulse of the sume *duplicate second* (for a double oscillation is registered) shall be *simultaneously* announced, however distant; or the index in the various rooms of a house beat in perfect unison with the parent one! This wonderful power is entirely derived from the electricity of the earth: the pendulum conducts, and is the treasury of that power, and two simple wheels and their attachments, with the dead escapement, complete the machine. By an ingenious provision, Mr. Bain's electric clock at the manufactory extinguishes the gas-light which illuminates its dial at half-past 12 precisely."

Mr. Bain has invented and patented another kind of electric clock, the clock being in Glasgow, and the pendulum in Edinburgh! By means of the electric telegraph along the railway, constructed by Mr. Bain, he intimated his wish that the pendulum at the other end of the line should be put in motion. The clock was placed in the station-house in Glasgow, the pendulum belonging to it in the station-house at Edinburgh,—the two being 46 miles apart. They were joined by means of the wire of the telegraph in such a manner as that, by a current of electricity, the machinery in the clock in Glasgow was made to move correctly according to the vibrations of the electrical pendulum in Edinburgh. Thus, in like manner, were England and Scotland united in one grand chronometrical alliance: a single electrical pendulum of this description placed in the Observatory at Greenwich would give the astronomical time correctly throughout the whole country.—*Scotch Reformers' Gazette.*

Chemical Science.

MOLECULAR ACTIONS OF CRYSTALLINE PARTICLES.

Dr. A Waller, in a paper of "Observations" communicated to the *Philosophical Magazine*, No. 185, shows that:—

1st. The crystals are formed on the side exposed to the action of direct or diffused light.

2nd. They are not formed during the night, when the radiation from the earth is sufficient to cause the deposition of water.

3rd. Green glass, which retards photographic action, likewise impedes this deposit.

In an experiment which is now going on, a bottle of pale green common glass is exposed to the north, while another of white glass is placed in a southern aspect. The first became covered with minute crystals, in size averaging about a millimetre, which have remained stationary for a week; the second is covered with arborescent ramifications, which are daily increasing.

Several familiar, but hitherto unexplained phænomena, may, in the experimenter's opinion, be easily accounted for by these molecular actions.

The formation of hail, Dr. Waller considers to be an instance of an action precisely similar to that which causes the deposition of the solids of gaseous and liquid particles. If we admit the influence of this force on the globular vapours of water, it is not at all improbable that certain conditions may arise in nature when these vapours may be much more liable to this influence than we find them in our imperfect experiments. We have seen that a solution of sulphate of soda or water in a pure state may be brought by the abstraction of caloric to such a condition of unstable equilibrium, that the slightest perturbating cause will immediately reduce them to a solid form.

If we admit that the globules which form the clouds are capable of being placed in a similar condition, we have sufficient data to explain all the phenomena that occur in the production of hail. Any nucleus formed within a cloud in this state, would create around it a deposition of all the neighbouring particles; aud the size of the hailstones would be dependent upon the thickness of the cloud it had to traverse. In the storm at Ordenburg, in 1825, mentioned by Dr. Eversman, pyrites was found in the centre, and had acted like a nucleus round which the crystallization had taken place. Where the centre is not formed by a foreign body of this sort, it has frequently been mentioned that it consisted of an opake nucleus of a spongy nature, like congealed snow, which may be easily accounted for. The succession of concentric layers would be caused by the passage of the particles through strata of liquid globules not all at the same temperature; and the radiated structure indicates a gradual increase of *crystalline action proceeding* from the centre. The temperature of *the hail-stones, which* has generally been found below the freezing-*point, is a further* corroboration of this view.

The formation of butter is likewise, in all probability, another instance of molecular action of the same nature. It is well known that after the cream has been agitated for a certain length of time, the globules suddenly coalesce, and by their union butter is produced. The sudden appearance of this product is the more remarkable, as it takes place at different temperatures; although more quickly at some than others, and not gradually, as might have been expected, which precludes the idea of its being owing to any caloric developed by friction. The most minute observations have been unable to shew any material alteration in the appearance of the fatty globules at the moment before the butter is formed. Little doubt can be entertained of its being caused by some molecular action, or engendered in the globules by the continued agitation they have undergone.

CRYSTALLOGRAPHY, AND A NEW GONIOMETER.

Dr. Leeson has submitted to the Chemical Society, a New System of Crystallography, to be found in their published Memoirs. His Goniometer consists in adapting to a microscope a polarizing prism. The crystal observed through this polarizing eye-piece of course presents two faces instead of one; but by turning the eye-piece until these two angles are made to correspond, the true angle of inclination from the axial line is obtained, and its value is read off from a graduated circle within which the polarizing arrangement moves.

REICHENBACH'S NEW IMPONDERABLE.

This new doctrine is akin to Animal Magnetism, and will be found enunciated in a pamphlet published in Germany early in the year, and translated into English.

The fundamental idea of Reichenbach's theory is the idea of polarity. This connects it with magnetism and the allied sciences.

The result of his observations and experiments is the existence (real or accredited) of a new Imponderable.

The human beings susceptible to the force in question are generally those whose nervous power is more or less deranged; although not invariably so.

Magnets act upon them. Independent of contact, the proximity of a magnet causes sensations of a peculiar and varied description. They also attract the hand, &c. So do other substances previously magnetized, *e. g.* magnetized water.

Magnets are luminous; and patients under the influence of the force in question see the light at once.

Crystals act as magnets have been described to act, *i. e.* so far as human nerves are concerned. But crystals do not act as magnets with regard to iron.

Hence the separation of the present force from the magnetic force; *i. e. the separation* of the force that acts on human nerves from that *which acts* on iron.

Both these are combined in the magnet. In crystals, the latter is *isolated.* Crystals transfer this force to different substances in

different degrees. The leaves of a book are pre-eminently insusceptible.

The name proposed by Dr. Reichenbach for this new force is *Od;* a word which means nothing, and consequently engenders no wrong ideas.

The force abstractedly is *Od.* As found in crystals, it is crystallod; as found in light, photod; as found in living beings, biod; as found in heat, thermod.

Such is the theory, and such the nomenclature, of Dr. Reichenbach, the German chemist; and his translator, Dr. Gregory, of Edinburgh, confirms some of the experiments.*

THEORIES OF VOLCANOES.

DR. DAUBENY, F.R.S. has read to the Ashburnham Society, an elaborate paper "On the Site of the Ancient City of the Aurunci, and of the Volcanic Phenomena which it exhibits; with some Remarks on Craters of Elevation, on the Distinctions between Plutonic and Volcanic Rocks, and on the Theories of Volcanic Action which are at present most in repute." This valuable paper has been communicated to *Jameson's Journal*, No. 82, wherein it occupies forty pages. We quote the following synoptic l results:—

There are only two m les of explaining Volcanic Action which are worthy of attention when viewed by the lights of modern science.

One set of philosophers, inferring from the oblate spheroidal figure of the globe, that it was once in a state of fluidity from igneous fusion, and again, presuming, from the increasing temperature observed as we descend deeper and deeper into its recesses, that it may retain enough of its heat at the present time to be preserved in a state of fusion below certain depths,—propose a very simple mode of explaining the evolution of melted matter from volcanoes, by attributing it to the contraction of the crust of the globe upon its fluid contents, by which a portion of the latter is from time to time expressed at the points of least resistance.

Others, considering that all the matters ejected from a volcano contain an inflammable base united with oxygen—that the latter need not be supposed to have been present in the interior of the earth in quantity sufficient to combine with all the principles for which it could exert an affinity—and, therefore, that these bases may, without violence, be supposed to exist in an unoxidized state at a certain distance from the surface—have proceeded to show that, assuming such to be the fact, all the phenomena of volcanic action may be explained according to the received principles of chemistry, by the access, first, of sea water, and afterwards of atmospheric air, to the interior of the globe.

For, granting that no other of the bases which enter into the composition of lava would inflame on the approach of water, the metals of

* *We quote this outline from the* Historical Supplement *to* Felix Farley's *Bristol Journal,—a remarkable appearance, by the way, in newspaper history.*

the alkalies, at least, which constitute sometimes as much as one-tenth of the entire bulk of the ejected matter, would certainly do so; whence must result a considerable evolution of hydrogen, and a generation of heat sufficient to cause all the unoxidized substances in the vicinity to unite with the oxygen presented to them.

But, without entering into a complete exposition of this theory, Dr. Daubeny thinks it must on all hands be admitted, that if the relative merits are to be decided by its capability of explaining the phenomena, it may fairly claim the preference over the rival hypothesis.

REPRODUCTION OF NITRIC ACID BY CAVENDISH'S EXPERIMENT.

DR. DAUBENY has stated to the British Association, the result of some experiments he had instituted with the view of ascertaining whether the production of Nitric Acid by Electricity, as was first effected by Cavendish, really arose from the direct union of oxygen with nitrogen, or was effected indirectly through the presence of minute portions of ammonia. For this purpose, he deprived the air, through which the electrical sparks were to be passed, of water and of any traces of ammonia that might have been contained in it, by allowing it to stand in contact with concentrated sulphuric acid for some time previous to the commencement of the experiment. Even in this case, although the air had been in contact with no liquid except the mercury over which it was confined, the usual diminution of volume took place after the electrical sparks had been passed through it; and solution of litmus, when introduced into the tube, became sensibly reddened. Hence the author infers, that nitrogen does combine directly with oxygen, as it is now known to do with carbon; but he still questions whether it can do so with gaseous hydrogen, since ammonia cannot be formed, as nitric acid is, by means of electricity; and, as in all the cases in which ammonia has been produced artificially, one of the elements appears to have existed in what is called a nascent state. But if nitrogen can be made to combine directly with oxygen, how comes it that, through the operation of thunder-storms, the composition of the whole atmosphere has not before this time been changed by the production in it of considerable quantities of nitric acid? This the author explains by the small amount of heat generated by the union of the two gases, owing to which only those particles combine which lie contiguous to *the line of the electrical spark:* whereas, in other cases, as in that of the union of oxygen with hydrogen, so much heat is generated by the union of those particles which are affected by the passage of the electrical spark, that a condensation of other portions of the mixture results; whence will arise an union of more of the particles, and an extraction of a larger amount of heat. In this way, the explosion propagates itself through all parts of the *mixture with a* rapidity which causes it to be considered by us as *instantaneous.* In all cases, however, in which gaseous elements that can remain together without acting upon each other are made to unite, the *modus operandi,* whether it be by electricity, heat, or (as in the

case of porous bodies,) by adhesive affinity, appears to be the same; that is, such a condensation of the respective gases as shall bring their particles within the sphere of their mutual affinity.—*Athenæum*, No. 987.

THE DECOMPOSITION OF WATER INTO ITS CONSTITUENT GASES BY HEAT.

THE substantial points of this discovery, by Professor Grove, were detailed to the Chemical Section at the late Meeting of the British Association, the more popular explanation being reserved for the discourse which this gentleman was invited to give. We have availed ourselves of both opportunities; and thus are enabled, we hope, to offer a more complete abstract than has elsewhere been published.

The composition of water, it is now well known, was synthetically proved by Cavendish, who, by exploding oxygen and hydrogen gases in closed globes, produced a quantity of water equal in weight to that of the mixed gases. The experiment was afterwards tried by the French philosophers on a large scale, and the weight of the water produced by burning hydrogen in oxygen proved to be exactly that of the gases employed.

Having given a sketch of the progress of eudiometry from the time of Priestley to the present, Mr. Grove went on to explain a form of Volta's eudiometer, which he constantly used in his researches, and which, he considered, offered many advantages over any other form. It is simply a graduated tube, into the closed end of which is fused a piece of platinum wire, which, when connected with two cells of a Grove's nitric acid battery, becomes immediately white hot, and consequently effects the combustion of gases in a most manageable manner. By an apparatus of this kind, ammonia, camphor, the compounds of oxygen and nitrogen, had been most accurately analysed. It was a curious fact, that hydrogen gas, when exposed to the influence of this ignited wire, always exhibited the presence of some oxygen gas; and it was found impossible to pass pure hydrogen gas through water without its becoming combined with some oxygen. This may be proved by placing a small chip of phosphorus in it, when it will be found that sufficient oxygen is present to render it luminous in the dark.

When hydrogen and carbonic acid were exposed to the ignited wire, there was a contraction of one volume of the gases, and carbonic oxide was formed in the tube, with some water. If, on the contrary, hydrogen and carbonic oxide were exposed to the heated wire, the gases expanded in volume, and the carbonic oxide was converted into carbonic acid. Here are two dissimilar results obtained under apparently exactly the same conditions. Pursuing still further the investigation of this very curious subject, it was discovered that when the ignited wire converted water into steam, there was always some decomposition *of that steam,* and a small bubble of mixed oxygen and *hydrogen gases was invariably* formed.

The most simple form of the experiment is as follows:—The tube, being filled with water, is placed in an inclined position, and the flame of a spirit-lamp made to play upon its upper part until a portion of it is converted into steam. The contact is then made between the battery and the wire, and, as the wire becomes instantly white hot, the decomposition is effected, and a bubble of mixed gas formed. This bubble appears to be formed by the first action; for, however long the operation may be continued with the same steam, no further decomposition results: remove the lamp, and allow the water again to fill the tube, and again convert some of it into steam, and another bubble may be formed. The experiment was tried under a different form, and the same result produced by the electrical spark, to the heat of which alone Mr. Grove thinks the decomposition of the water is due. A wire is soldered into a tube, and another bent wire passed up through the water in the basin to within a short distance of the end of the fixed wire. Steam being formed in the tube by means of the spirit-lamp, a Leyden jar was discharged, and the passage of the spark between the wires effected the decomposition of a small portion of the steam.

As it became desirable to collect a sufficient quantity of the gas for analysis, another form of apparatus was employed. By this arrangement, the wire is made to heat the water in the tube. Steam is thus formed, and then decomposed. Connection being broken with the battery, the water again flows into the bulb, and, the process being again and again repeated, a quantity of gas sufficient for analysis is collected in the upper part of the bent tube. Having most satisfactorily confirmed these results, it became very desirable to ascertain if they might not be repeated by the influence of heat only. It might be thought by many that, in the form of the experiments described, the electrical current in some way influenced the case. This, however, electricians would see could not be the result. Still, to remove all doubt, the following form of apparatus was constructed, and the decomposition effected solely by the heat applied:—to two silver tubes are fitted two platinum collars, and connecting one with the other is a platinum wire bored through its length. The tubes being filled with water, heat is applied to convert a portion into steam, at which time a spirit-flame, driven by a blowpipe, or, still better, the oxyhydrogen flame, is brought to bear upon the pierced wire, so that it can be at once brought to a white heat but little below that at which platina is fused. By this means, the mixed gases are readily obtained, and collected in the upper part of the tube; by removing the heat, water again fills the tubes, and the operation can be repeated. Many other modes of performing the experiment were named; the most simple being that of fusing platina wire by the blowpipe, allowing the fused globule to fall into water, and collecting the gas in a tube as it rises.

Thus, it appears to Mr. Grove that he has proved the power of heat to decompose water. In the very beautiful experiments of M. Boutigny, a peculiar condition of water is produced, to which the term

spheroidal state has been applied.* This condition has been attributed to the repulsive action of steam formed at the moment the water is projected on the heated metal. Mr. Grove, however, thinks that the oblate spheroid which is formed when water is placed in a heated capsule, and which evaporates so very slowly, is due to the decomposition to which he has now shown water is subject under the action of a considerably elevated temperature.

In the remarks which followed this communication, both in the Chemical Section and after the evening meeting, it was suggested by Sir John Herschel, and also by Dr. Playfair, that the decomposition might probably be due to the effect of contact with the heated metal—the phenomena of catalysis, of which it is known platinum is a most active agent. Had vessels of quartz or agate been used, the question would have been more satisfactorily settled than it is at present. Dr. Faraday was, however, disposed to regard the phenomena as due to the influence of heat, and pointing out a certain law intimately connected with the corpuscular constitution of matter. By the action of heat, water was converted into steam—the cohesion of the particles of water were loosened—and now, by increasing the heat, it appeared to him that not only was the attraction of aggregation destroyed, but the atoms carried beyond the influence of chemical affinity.—*Pharmaceutical Times*, No. 5.

ACTION OF WATER ON LEAD.

A PAPER has been read to the British Association, "On the Presence of Atmospheric Air and Uncombined Chlorine and Carbonic Acid found in the Water of some of the Wells in the suburbs of Southampton, and their Action on Lead," by H. Osborn. The principal object of this paper was to caution persons residing in the neighbourhood of Southampton against the use of leaden pipes for conveying water, and to induce them to avoid the use of lead in any form for that purpose, without having the water previously examined, in order to ascertain whether it possesses the property of acting upon the metal and holding it in solution. The author brought forward several instances of the serious consequences which had resulted from the use of water impregnated with lead, and pointed out the different solvent principles found in the water; one of which was uncombined chlorine, discovered in a spring in the New Forest. The water possessed the property of bleaching Brazil paper, and reddening litmus paper by evaporation. The amount of uncombined chlorine was estimated as chloride of silver, by deducting the amount of the latter contained in 20 ounces of water from that of the chlorine contained in the solid contents, the former weighing 1·2 more than the latter, thus indicating 0·296 of uncombined chlorine, which is capable of uniting with 0·864 of lead, forming 1·16 of chloride of lead in the imperial pint. The lead held in solution by carbonic acid, and the oxygen of *atmospheric air*, was converted into chromate of lead, and estimated

* See Year-book of Facts, 1846, p. 188.

as chloride of lead, which indicated 0·25 or 0·2 of the oxide in twenty ounces of water. The solid contents in an imperial pint were found to vary from one grain to three grains, and to be composed of the chlorides of sodium, calcium, and magnesium, sulphate of lime, silica, and vegetable matter. Notwithstanding the preservative property, which the salts contained in spring water are said to possess, by forming an insoluble crust in the interior of the pipes, it was found that the leaden pipes had been in use for some years, and the action of the water on the lead still continued with as much energy as when they were first laid down; thus showing the presence of the above solvents, and that they met with no resistance from the presence of the saline matter.

Dr. Daubeny made some remarks pointing out the importance of the inquiry of Mr. Osborn, and the necessity of paying attention to the condition of the water supplied to towns through leaden pipes, or received in leaden cisterns. Mr. Pearsall stated that he found the presence of lead may be constantly removed from the water by the action of carbon, and that lead may be always separated by well agitating the water in contact with the air, and mixing up the sedimentary deposits. The subject excited considerable attention, and many gentlemen joined in the conversation; all of them adducing additional evidence of the importance of investigating the condition of water supplied to large towns.—*Athenæum*, No. 986.

SALTS IN WATER FOR DOMESTIC PURPOSES.

A PAPER has been read to the Paris Academy of Sciences, on the effects of calcareous Salts in potable Water, received from M. Dupasquier. He states that all the calcareous soluble salts, with the exception of the bicarbonate of lime, are injurious to the stomach, and also harden the vegetables which are cooked in the water containing them. The bicarbonate of lime, however, produces no bad results; and is, on the contrary, favourable to *digestion*, in the same way as the bicarbonate of soda.—*Athenæum*, No. 966.

GASES IN SEA-WATER.

M. DUMAS has read to the Academy of Sciences, at Paris, the Report of a Committee on the paper of M. Lewy, relative to the composition of the Gases which are held in solution by Sea-water. M. Lewy has stated, that whilst the water of rivers contains per litre 40 cubic centimètres of gas, that of the ocean contains only 20 cubic centimètres; and that this quantity varies according to the hour of the day at which the experiment is made, as he shows by the following table:—

	Morning.	Evening.
Carbonic acid	3·4	2·9
Oxygen	5 4	6·0
Azote	11·0	11·6
	19·8	20·5

The Committee report that they have verified the statement of M. Lewy, and found it to be correct.

ANALYTICAL RESEARCHES ON SEA-WATER.

A VALUABLE paper on this inquiry, by Professor Forchammer, has been submitted to the British Association. Among the leading results are comparative analyses of the proportions of salt in the Mediterranean, Atlantic, German Ocean, and Arctic Sea, deducing, as general propositions from them, that the quantity of salt decreases towards the pole, and also near the shores. Thus, in the ocean between Europe and America, the greatest quantity of saline matter is found in the tropical region, far from any land; where 1,000 parts of sea water contain 36·6 parts of salt. This quantity diminishes in approaching the coast, on account of the masses of fresh water which the rivers throw into the sea: it diminishes, likewise, in the westernmost part of the Gulf stream, to 35·9 in 1,000 parts of water. By the evaporation of the water of this warm current, its quantity of saline matter increases towards the east, and reaches, in N. lat. 39° 39′ and N. long. 55° 16′, its former height of 36·5. From thence it decreases slowly towards the north-east: and sea water, at a distance of from sixty to eighty miles from the western shores of England, contains only 35·7 parts of solid substances. In a conversation with Prof. Grove, in the chair, Dr. Daubeny, and others, it was elicited that a proportion of sulphuric acid, chlorine, and lime, is found in the Atlantic, and that the presence of ammonia in sea-water is attributed to living animal substances, and not to the fall of rain.

The following results are the mean of many analyses:—In the Atlantic, the proportion between *chlorine* and *sulphuric acid* is 10,000 to 1,188; this is the mean of twenty analyses, which differ very little from each other. In the sea between the Faroe Islands, Iceland, and Greenland, the same proportion, according to the mean of seventeen analyses, is 10,000 to 1,193. In the German Ocean, according to ten analyses, it is 10,000 to 1,191. In Davis's Straits, according to the mean of five analyses, it is 10,000 to 1,220. In the Kattegat, according to the mean of four analyses, 10,000 to 1,240.—Thus it appears that the proportion of sulphuric acid increases near the shores: a fact which evidently depends upon the rivers carrying sulphate of lime into the sea. The proportion between *chlorine* and *lime* in the Atlantic Ocean, according to the mean result of seventeen analyses, is 10,000 to 297; and in the sea between Faroe and Greenland, according to the mean of eighteen analyses, 10,000 to 300. Lime is rather rare in the sea around the West Indian Islands, where millions of coralline animals constantly absorb it,—the proportion, according to five analyses, being 10,000 to 247; and it is rather copious in the Kattegat, where the numerous rivers of the Baltic carry a great quantity of it into the ocean. The proportion is there, according to four analyses, 10,000 to 371.—*Athenæum*, No. 987.

ANTIQUITY OF THE AIR-GUN.

THE following curious fact is noticed in the *Mechanics' Magazine*, No. 1191:—Although the air-pump is a modern invention, yet the air-gun, which is so nearly allied to it in the construction of its valve and condensing syringe, existed long antecedent to it; for it is recorded that an air-gun was made for Henry IV., by Marin of Liseau, in Normandy, as early as 1408, and another was preserved in the armoury at Schmetau, bearing the date of 1474. The air-gun of the present day is, however, very different from the ancient one.

CONVERSION OF SULPHURETTED HYDROGEN INTO SULPHURIC ACID.

A PAPER on this subject, by M. Dumas, has been read to the Paris Academy of Sciences. After stating that he had found in various places sulphate of lime resulting from the action of Sulphuric Acid produced by Sulphuretted Hydrogen in its natural state, M. Dumas says:—"In great cities, and in London in particular, it has been remarked that large masses of iron exposed to the air experience erosions, which have been attributed to the presence of sulphurous gas in the air. This gas is supposed to result from the combustion of coal; but it would be well to ascertain whether the sulphuretted hydrogen exhaled from the numerous sewers does not contribute to the effect in question. These emanations of sulphuretted hydrogen, which are remarked in Paris as well as in London, may occasion a slow production of sulphuric acid, and consequently of sulphates where there are elements for the saturation. According to MM. Chevreul, Vogel, and Leroy, wherever alkaline sulphates exist in contact with organic matter, they may become the origin and source of a production of sulphuretted hydrogen. On the other hand, wherever sulphuretted hydrogen and the air are in contact with the humid remains of plants, sulphuric acid and sulphates will be reformed. Sulphur, then, may travel through the air from the sulphates which contain it, in large bodies of water, to lands which require it for vegetation or for the production of the animals which live on the plants produced by those lands. It is worthy of remark that yellow sulphur performs an important part in the production of all azoted substances of plants and animals; they contain on an average a 100th part of their entire weight. Thus, ten kilogrammes of dry azoted matter, which is about the quantity in a man of ordinary size, contain 100 grammes of sulphur. The population of France, therefore, represents a quantity of sulphur equal to two millions of kilogrammes; and we may estimate the total quantity of sulphur in the animal creation of France at twenty millions. A regular movement on the surface of the globe which tends to the continual supply of sulphur to the beings who inhabit it, must be regulated by laws worthy of the meditation of all the friends of natural philosophy."—*Athenæum*, No. 993.

AMMONIA CONVERTED INTO NITRIC ACID.

WHEN a current of damp air, mixed with Ammonia, passes over chalk, moistened with a solution of potash, the temperature being

raised to 100°, there will be found, at the end of some days, a notable quantity of nitre of potash. This experiment, which accords with all the works of M. Kuhlmann on nitrification, was suggested to M. Dumas by observations which he had recently made on the conversion of sulphuretted hydrogen into sulphuric acid.—*Literary Gazette*, No. 1560.

COAL GAS LIGHTING IN CHINA.

Whether, or to what extent, the Chinese artificially produce illuminating Gas from bitumen Coal, we are uncertain. But it is a fact, that spontaneous jets of gas, derived from boring into coal-beds, have for centuries been burning, and turned to that and other economical purposes. If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers on a large scale; and have evidently been so ages before the knowledge of its application was acquired by Europeans. Beds of coal are frequently pierced by the borers of salt water; and the inflammable gas is forced up in jets twenty or thirty feet in height. From these fountains, the vapour has been conveyed to the salt-works in pipes, and there used for the boiling and evaporation of the salt; other tubes convey the gas intended for lighting the streets, and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the salt-works, and there forms separate chimneys or columns of flame.

One cannot but be struck with the singular counterpart to this employment of natural gas, which may be daily witnessed in the valley of the Kanawha, in Virginia. The geological origin, the means of supply, the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are remarkably alike at such distant points as China and the United States. Those who have read, even of late, the account of the recent extraordinary additional supply of gas, and the services it is made to perform at the Kanawha salt-works, must be impressed with the coincidence of all the circumstances with those which are very briefly stated in the previous paragraph in relation to China. In fact, the parallel is complete.—*From a Pamphlet by Mr. R. C. Taylor, F.G.S. Philadelphia.*

GAS-LIGHTING BY WATER.

So long ago as the year 1833, M. Jobard discovered, in France, the means of causing hydrogen gas, obtained from water, to burn with double the illuminating property of ordinary coal gas. M. Jobard obtains his hydrogen gas by the decomposition of steam in vertical retorts filled with incandescent coke, and unites the gas, at the moment of formation, with hyper-carburetted gas, produced by the distillation of any hydro-carburet—as oil, tar, naphthaline, and other products at present rejected by our ordinary gas works. It is of no moment whence his hydro-carburets are produced; indeed, the substances

which are rendered useless and injurious to the manufacture of the gas, by the present mode of operating, are precisely those which are the richest in illuminating properties. M. Jobard's process and its details have been submitted, since its invention in 1833, to several Commissions of Inquiry both in Belgium and France, and the reports of these have been uniformly favourable both as to its cheapness and the higher illuminating power of the gas so produced. In a recent number of the *Bulletin du Musée d'Industrie*, the inventor gives a full account of his process, which is about to become public property; and mentions that it has been used in a manufactory near St. Etienne, in Dijon and Strasburg, partially in Lyons and Paris, and by private individuals in Dublin and London. He modestly concludes his paper by observing that he will not be accused of exaggeration when he states "that there is some value in a process, the principle of which is to decompose water, a substance of no value, by means of coke, which is of very little value,—as under this process one pound of oil, which costs a halfpenny, will supply a burner giving a light equal to ten candles during twenty hours."

LIGHTING AND HEATING BY CARBONIC OXIDE.

A PATENT has been taken out, by Mr. J. Constable, of London, for a method of preparing Carbonic Oxide Gas from Anthracite, in blast furnaces, by aid of heated steam and air; passing it, for illumination, through oil of turpentine, to increase its brilliancy; and, for heating purposes, mixing it with air supplied by a gasometer to the burner. Materials valuable as manure are obtained from the ashes; cyanide of potassium by washings, and ammoniacal products by aid of steam: the scarcity and high price of guano thus, as in Dr. Playfair's researches, and in the scheme for condensing sewage, leading to a fair prospect of a cheap supply of artificial equivalents.

CRIMSON FLAME FOR THEATRES.

MR. STAMPER, a pyrotechnist, of Bradford, has communicated to the *Mechanics' Magazine*, the following process for producing a rich Crimson *Flame;* observing—It must not be confounded with the red reflection, which is not a flame but a coloured fire—a powder, whereas the crimson flame is a liquid.

Preparation.—Procure 1 oz. of spirit of salt, put it into a cup, and introduce as much powdered nitrate of strontia as will make a paste. Now put a gridiron over a slow fire, and on it place the cup: allow it to remain in a boiling state for two or three hours, until it is very nearly dry. Avoid the deleterious orange fumes that are evolved. When the mixture has cooled, add about 4 ozs. of the liquid called pyroxylic spirit, and pour the whole into a white bottle for use. On standing, it deposits a sediment: do not use much of this.

To use it, wind some common lamp-cotton on a nail into a ball of about two inches; drive this into the end of the torch, or the top of the altar, or the helmet of a "fire-fiend:" pour on it just as much

of the liquid as the cotton will absorb, without allowing it to fall off in drops, and waste; then light it with a bit of paper, and you will see the effect.

PLATINA AND THE VOLTAMETER.

Dr. Robinson has read to the British Association, a paper of experiments, the principal point of which is to show, that when the electrodes of a Voltameter are covered with a finely comminuted Platina, the decomposition of water is effected by a less powerful current of electricity. He attributes this to energetic capillary attraction, involving the action of heat, as in Grove's recent discovery. Mr. Grove agreed with Dr. Robinson as to the cause of the increased effect; and, in commenting on the subject, he alluded to the peculiar fact, that ebullition in no circumstances seems to take place excepting from the surface of solid bodies. The bubbles of air in a glass of champagne, for example, always rise from the bottom or sides of the glass; and the steam of boiling water always collects in bubbles against the solid surface, and never rises from amongst the particles of the liquid. He was of opinion that, supposing it possible to heat water without contact with a solid surface, the fluid would not boil till the whole mass burst into ebullition at once.—*Literary Gazette*, No. 1552.

OBSERVATIONS ON CAPILLARITY. BY PROF. HENRY.

In 1839, the author presented the results of some experiments on the permeability of lead to mercury; and subsequent observation had led him to believe that the same property was possessed by other metals in reference to each other. His first attempt to verify this conjecture was made with the assistance of Dr. Patterson, at the United States Mint. For this purpose, a small globule of gold was placed on a sheet of iron, and submitted to the heat of an assaying furnace: but the experiment was unsuccessful; for, although the gold was heated much above its melting point, it exhibited no signs of sinking into the pores of the iron. The idea afterwards suggested itself, that a different result would have been obtained had the two metals been made to adhere previous to heating, so that no oxide could have been formed between the surface. In accordance with this view, Prof. Henry inquired of Mr. Cornelius, of Philadelphia, if, in the course of his experience in working silver-plated copper, in his extensive manufactory of lamps, he had ever observed the silver to disappear from the copper when the metal was heated. The answer was, that the silver always disappears when the plate is heated above a certain temperature, leaving a surface of copper exposed; and that it was generally believed by the workmen, that the silver evaporates at this temperature.

Professor Henry suggested, that the silver, instead of evaporating, merely sunk *into the pores* of the copper, and that by carefully re*moving the surface* of the latter by the action of an acid, the silver *would reappear.* To verify this by experiment, Mr. Cornelius heated

one end of a piece of thick plated copper to nearly the melting-point of the metal; the silver at this end disappeared, and when the metal was cleaned by a solution of dilute sulphuric acid, the end which had been heated presented a uniform surface of copper, whilst the other end exhibited its proper coating of silver. The unsilvered end of the plate was next placed, for a few minutes, in a solution of muriate of zinc, by which the exterior surface of copper was removed, and the surface of silver was again exposed. This method of recovering the silver, before the process of plating silver by galvanism came into use, would have been of much value to manufacturers of plated ware, since it often happened that articles were spoiled in the process of soldering, by heating them to the degree at which silver disappears.

It is well known to the jeweller, that articles of copper, plated with gold, lose their brilliancy after a time, and that this can be restored by boiling them in ammonia: this effect is probably produced by the ammonia acting on the copper, and dissolving off its surface, so as to expose the gold, which, by diffusion, has entered into the copper.

A slow diffusion of one metal through another probably takes place in cases of alloys. Silver coins, after having lain long in the earth, have been found covered with a salt of copper. This may be explained by supposing that the alloy of copper, at the surface of the coin, enters into combination with the carbonic acid of the soil, and being thus removed, its place is supplied by a diffusion from within; and in this way it is not improbable that a considerable portion of the alloy may be exhausted in the process of time, and the purity of the coin be considerably increased.—*Proceedings of the American Philosophical Society.*

NEW METALS.

THERE have been three New Metals lately discovered,—*Pelopium*, *Niobium*, and *Ruthenium*; the first two were procured from the Bavarian Tantalite by Prof. H. Rose; and the latter was found associated with the ore of platinum by Prof. Claus. Pelopium and Niobium exist in the mineral under the form of Pelopic and Niobic acids. (*Comptes Rend.*, Dec. 1844.) They resemble the tantalic or columbic acid so closely in all their properties, that it becomes difficult to separate them from each other. Prof. Rose has, however, obtained the Niobic acid perfectly pure, and the greatest difference between it and columbic acid appears to be, that it forms, when heated with charcoal and chlorine, a chloride that is colourless, infusible, and very slightly volatile, whereas the Tantalic acid affords a chloride yellow, very fusible and volatile.

The Niobium is readily obtained in its metallic state, by submitting the chloride to the action of dry ammonia, and applying heat, when the metal is reduced with the disengagement of the hydrochlorate of ammonia.

The Ruthenium discovered by Prof. Claus, (Chem. Gazette, Feb.

1845,) as already stated, is associated with native platinum, and is procured from what is called the platinum residue, (the residue after treating the platinum ore with nitromuriatic acid.) It is first fused with nitre at a red heat for about thirty minutes, and the fused mass treated with water and dilute acids, which extract the osmium and iridium; the solid matter left is now fused with its own weight of nitre, and kept at a white heat for two hours: the mass is taken out, while still red hot, with an iron spatula, and after cooling, reduced to a coarse powder, which is extracted with distilled water: so soon as the water becomes clear, it is decanted. It contains rutheniate, chromate, and silicate of potash. Nitric acid is added cautiously, until the alkaline reaction has disappeared; by this means, oxide of Ruthenium and potash, and some silicic acid, are precipitated, as a velvet black powder: after washing this powder, it is dissolved in muriatic acid, evaporated until the silica separates as a gelatinous mass; when it is diluted with water, and filtered. It must not be evaporated to dryness for the more complete separation of the silica, because the chloride of Ruthenium is thereby decomposed into an insoluble protochloride. The filtered solution, which is of a beautiful orange yellow colour, is evaporated down to a very small volume, and mixed with a concentrated solution of chloride of potassium, when the salt $KCl + RuCl^2$ separates in reddish-brown crystals.—*Silliman's Journal*, No. 1, Sec. Series.

EXTRACTION OF PALLADIUM FROM GOLD.

M. Dumas has submitted to the Paris Academy of Sciences, specimens of Palladium—an ingot, a plate, and a lump of spongy palladium, extracted by MM. Schmidt and Johnson from the auriferous mineral of the Brazilian mines. Six thousand ounces have already been obtained from this mineral, which generally contains palladium, gold, silver, copper, and iron, by first treating it with nitric acid: the silver is then precipitated by a solution of chloride of sodium: pieces of zinc put into the liquor throw down the palladium and copper: these metals are again dissolved in nitric acid and supersaturated with ammonia, which retains the copper in solution: the ammoniacal salt of palladium is heated to redness, and the metal is left in a spongy state: it is then forged as platina is. The method hitherto employed for extracting palladium from platina ore is a long and costly one; but this new treatment will render palladium much less rare in commerce.—*Literary Gazette*, No. 1553.

REDUCTION OF SILVER ORES WITHOUT QUICKSILVER.

Two new modes of reducing Silver Ore have been recently introduced from Germany into Mexico, which promise ere long to supersede entirely the use of that expensive agent, Quicksilver. The discoverer is a Mr. Ziervogel. According to the present mode, the ore is *first calcined with salt*, which converts the sulphur into a chlo*ride; it is then at once removed from the furnace to a suitable tub, or other vessel, and a* hot solution of salt poured over it, which imme-

diately takes up the chloride of silver, and holds it in solution; the liquid is then drawn into another vessel, containing metallic copper, when the solution is decomposed, the silver being precipitated; the liquor, by a simple process, is brought to its original starting point, and may be used over and over again with but little loss of salt. In the second process, the ores, or sulphurets, are carefully roasted in a reverberatory furnace, until they are converted into sulphates, when they are thrown into a suitable vessel, and boiling water poured over them, which immediately dissolves the sulphates; the liquid is then drawn off, and the silver precipitated by the same method as the first process. The latter process is best adapted for ores which contain a large portion of iron and copper pyrites, as a certain quantity of sulphur must be present, to insure the conversion into a sulphate.—*Mechanics' Magazine*, No. 1193.

TRANSPARENCY OF QUICKSILVER.

M. MELSENS has found that Quicksilver in minute globules is transparent, and transmits a blue light, slightly tinged with violet. These globules are formed when a fine stream of water is dropped on a mercury bath; the drops of water, in consequence of falling with some force, become covered with a thin pellicle of mercury, which present the fact here stated. The result has been verified by Arago.—*L'Institut*, No. 601.

FUSION OF ALLOYS.

M. PERSON has read to the Academy of Sciences, at Paris, an account of his experiments on the Fusion of Alloys. The result of them, he says, is a conviction that the heat required for a mixture of metals may be known beforehand by a mathematical calculation, founded on a knowledge of the precise degree of heat required for the fusion of each metal in a separate state.

PLATINISING BY THE MOIST WAY.

THIS process succeeds best when we make use of a dilute solution of the double chloride of soda and platina. Three immersions suffice; between each immersion it is necessary to dry the surface with fine linen, rubbing rather briskly, after which it must be cleaned with levigated chalk before re-immersion. When copper has been gilded in the moist way, the gilt surface has not a beautiful tint; but, if the copper be previously covered with a pellicle of platina, a very beautiful golden surface may be produced.—*Pharmaceutical Times.*

PROCESS OF COATING IRON AND ZINC WITH COPPER, WITHOUT CYANURET OF POTASSIUM.

THE great advantages which would arise from perfecting a plan, whereby the easily oxidisable metals, such as Iron and Zinc, could be coated with Copper at a cheap rate, induced Messrs. Elsner and Philip, of Berlin, to undertake a series of experiments, to ascertain [whether this coul]d not be effected more economically than by employing

the Cyanuret of Potassium; and in this they have been successful. For coating iron, the article must be well cleansed in rain or soft water, and rubbed, before immersing it in the solution, which may be either chloride of potassium, chloride of sodium, with a little caustic ammonia added, or tartrate of potash, with a small portion of carbonate of potash. At the extremity of the wire, in connexion with the copper, or negative pole of the battery, is fixed a thin flattened copper plate; the article to be coated is attached to the wire from the zinc, or positive pole, and both are then immersed in the exciting solution, the copper plate only partially. The liquid should be kept at a temperature of from 15° to 20° Centigrade, and the success of the operation depends greatly on the strength and uniformity of the galvanic current. When the chlorides are employed, the coating is of a dark natural copper colour; and with tartrate of potash it assumes a red tinge, similar to the red oxide of copper. When sufficiently covered, the article is rubbed in sawdust, and exposed to a current of warm air to dry; it will then take a fine polish, and resist all atmospheric influence. In coating zinc with copper, the same general principles will apply as for iron; only observing that, in proportion to the size of the article, the galvanic current must be less powerful for zinc. The surfaces must be perfectly smooth, and for this reason it is well to rub them thoroughly with fine sand, and polish with a brush. Tartrate of potash is the best existing liquid for coating zinc. By very simple means, large articles in iron and zinc may be coated with copper by the above cheap chemical solutions, which could not, at any former period, be effected, from the high price of the cyanuret of potassium.—*Mining Journal.*

CORROSION OF IRON RAILS IN AND OUT OF USE. BY R. MALLETT.

The researches on this subject are still in progress,—experiments are being made upon six different lines of Railway. The principal facts already ascertained are:—1st. That there is a real difference in the rate of corrosion between the rails in use and out of use:—that this appears to be connected with their peculiar molecular condition so induced. 2nd. The determination of the complex conditions as to magnetism, which affect rails some time in use, producing both induced and permanent magnetism in the rails, each rail being magnetic with polarity, and having from four to eight separate poles each.

Mr. Hunt stated his confirmation of the experiments of Ritter—that magnetism had the power of protecting iron from corrosion; to which he referred the protecting influence exerted on the rails in use on railways.

RUST.

All the common metals, except tin, rust; they become duller and duller up to a certain degree, lose gradually their lustre, and then the *process goes no further.* Instead of this rusting being a destroyer of *the metal, it is a preserver*; for, even in the case of iron, which rusts *quickly as compared* with other metals, if it be dipped into tin, it

comes out coated with it, and it is preserved beautifully. If iron be exposed for a couple of hours to the action of water, the iron becomes quite corroded; but when tinned, the iron is protected, and the tin itself appears unaffected. How is it that this metal can protect itself, and the iron that is under it? It is simply owing to the substance formed on the surface by the attraction of oxygen, which is so adherent to the metal beneath. It gives a protection which no varnish, or any kind of application, can afford. Take a copper or a tin plate, they are both protected in their metallic state by a thin coat formed in the first instance of oxide. It is only because this coat is so exceedingly compact, close, and adherent, that it passes for nothing—a mere film of tarnish. You think you see, or touch, a piece of tin; you cannot detect the film, except by close examination. We know it is there, but it is only by optical phenomena that we can measure its thickness. It seems clean and beautiful, but if you rub it off, you give the metal beneath a new character; the beautiful lustre, however, passes off the first moment up to a certain point. The body formed by the combination of oxygen with iron is different. The oxide does not adhere to the metal beneath; it forms upon it little spots, or porous tumuli. It is not an investing varnish, but the process goes on through the pores of the rust, especially if the metal be placed in a damp atmosphere. This is the reason why we find a difference between copper, iron, tin, and lead, when used for roofs, or other external purposes. The iron alone is eaten into and destroyed, by this want of adhesion in its rust to the surface of the metal. "It is curious to observe, in some cases, how tin, a metal having a slight attraction for oxygen, protects other metals from oxidation. In Canada, tin plate is used for the roofs of houses; I am told that you are dazzled by the lustre of the setting sun upon the roofs; and there, although it is exposed to the atmosphere year after year, it does not decay, because the superficial coat of oxide protects the tin and iron beneath."—*Faraday.*

NEW MERCURIAL TROUGH. BY PROFESSOR LOUYET, OF BRUSSELS.

In small laboratories, in which one of the chief points to be aimed at is economy, in making researches on gases soluble in water, a small Porcelain Trough is commonly employed capable of containing twenty to twenty-five pounds of mercury. The size of the bell-glass is proportioned to the capacity of the trough; thus, only small quantities of gas can be collected,—quantities often insufficient to the desired experiments. With a view to obviate this inconvenience, Professor Louyet has modified the Mercurial Trough, so as to be able, without sacrificing economy, to collect considerable quantities of gas. This apparatus is formed of a small oblong oak box, to the bottom of which is cemented a glass, which fits exactly over its whole extent. The *external surface* of the glass is carefully polished and prepared. In *the centre* of one of its small sides (it is rectangular), is worked a *narrow and* deep groove parallel to the large sides of the right angle. *This opening* corresponds to a hollow in the bottom of the box. This

being done, the apparatus is arranged in the following way, to collect a gas over the mercury: — Procure bell-glasses made of emery-stoppered bottles, the bottom of which is removed; the edges of these receivers are prepared and rubbed with emery, and apply accurately to the ground glass, precisely like the receiver of an air-pump. The edges may be very slightly greased, or this precaution may be dispensed with. The receiver is placed on the ground glass, where it is kept fixed with one hand; with the other hand the stopper is removed, and it is entirely filled with mercury: then it is carefully re-stopped. This being done, a small quantity of mercury is poured into the box, so as to fill the small cavity, and to cover its bottom with a stratum of some millimetres. The receiver may now be moved in all directions, and may be slid until it is over the small cavity, into which the extremity of the curved tube by which the gas is disengaged is adapted. To one of the angles of the box may be fitted a small iron stopcock, by which the mercury is drawn off when the operation is ended.—*Philosophical Magazine*, No. 188.

EASY REDUCTION OF CHLORIDE OF SILVER.

M. Levol states that this Chloride is decomposed by being boiled in a solution of potash in which a little sugar is previously dissolved; the sugar gradually reduces the metal in a short time, carbonic acid gas being disengaged: after due washing the metal is obtained in the pulverulent state.—*Journ. de Ch. Méd.; Philosophical Magazine*, No. 197.

CONVERSION OF THE SOLID FERROCYANIDE OF POTASSIUM INTO THE SESQUI-FERROCYANIDE. BY C. F. SCHŒNBEIN.

In a former notice, Prof. Schœnbein has shown that a solution of the prussiate of potash in water, placed in contact with an atmosphere of ozone, instantaneously destroys the latter, and is converted into the red Sesqui-ferrocyanide. Since that communication was made, he has ascertained that even the solid yellow salt very readily absorbs ozone, and is changed into the red one. If a crystal of the common prussiate be suspended in a balloon containing an atmosphere strongly charged with ozone, and kept in that state by means of phosphorus and water, it will soon assume the colour peculiar to the red cyanide, just in the same way as it would do when held in air containing chlorine. The surface of the crystal, after having remained in the ozonized air for about twelve hours, is changed into the red salt, which may be easily separated from the yellow nucleus by mechanical means. A crystal of about a cubic inch in bulk appeared after thirty-six hours' suspension in ozonized air covered with a crust of the red cyanide, at least one line thick; and in another case was seen a smaller crystal of the yellow salt entirely converted into the red one. Prof. S. hardly need say, that by changing the yellow compound into the sesqui-ferrocyanide, the cohesive state of the former undergoes a material alteration. The red crust surrounding the yellow nucleus is rather brittle, and consists of a heap of small crystals of the sesqui-ferrocyanide. It is worthy

of remark, that under the circumstances mentioned, the yellow prussiate becomes moist, and exhibits in that state a very strong alkaline reaction.—*Philosophical Magazine*, No. 86.

ARSENIC IN PAPER.

THE French government having been informed that several poisonous ingredients were used in the manufacture of various kinds of Paper, directed a large quantity to be seized, and instructed Messrs. Payen and Chevallier, the chemists, to analyze the same. These gentlemen, by well executed experiments, detected the presence of Arsenic, lead, and copper, which, in their Report to the government, it is stated are present in consequence of the *debris* of coloured papers, scraps of which owe their colour to salts of arsenic and copper, cards called porcelain, and paper coloured with red lead, all entering into the composition of the pulp used for the manufacture of paper. To detect the presence of arsenic, the paper was carbonized by sulphuric acid; the carbonized mass, being mixed with distilled water, was introduced into Marsh's apparatus, and arsenic produced; the presence of copper was recognized by minutely dividing the paper, and placing it in contact with pure ammonia; the copper is dissolved, and may be obtained on evaporation; the analysis for the detection of lead was more complicated, but equally successful. It is conceived that the quantity of arsenic, copper, and lead, contained in the paper submitted to the above experiments, and which was of that description used for wrapping up articles of merchandize, was very minute; still, it is equally interesting with regard to public hygiene, as well as to medico-legal researches, that it should be known that these poisonous ingredients do exist in paper in various proportions.—*Times.*

INSOLUBILITY OF CARBONATE OF NICKEL IN STRONG ACIDS.

A CORRESPONDENT of the *Mechanics' Magazine*, having found it impossible to dissolve Carbonate of Nickel, in the strongest acids, observes:—It has been recorded in the annals of chemical science that the carbonate of nickel requires to be *recently precipitated and still moist*, to dissolve in acids: so that, if the young chemist prepare it under the conviction that he can put it to any use, at any time, he will find himself, as I have seen, most grievously mistaken. In fact, oxides with this unexplained peculiarity ought always to be preserved in a moist state, and used as speedily after making as possible, else they will turn out to be *utterly useless* for anything but blowpipe experiments or fusions.

PHOSPHATE OF LIME.

PHOSPHATE of Lime, although insoluble in water, penetrates plants, and is deposited in their tissues. Bones which contain it crumble on the soil, and disappear under the influence of rain water. These facts have engaged the attention of M. Dumas; and he attributes them to two causes,—one interfering rarely and weakly, the other always and with remarkable intensity. The first is the influence of ammonia on

the solution of the phosphate; the second is the action of carbonic acid, which M. Dumas thinks is the true solvent of phosphate of lime. In fact, water charged with carbonic acid does dissolve great quantities of this salt. Slices of ivory placed in Seltzer-water were softened in twenty-four hours, and the water charged with the whole of the phosphate of lime of the ivory. This property, M. Dumas states, explains the transfer of phosphate of lime into plants. It shews how advantageous it would be to water plants with water charged, by means of carbonic acid, with phosphate of lime; it explains how bones fall to pieces and dissolve, exposed on the soil to the prolonged influence of rain-water charged with carbonic acid; it explains, too, how bones, in the animal economy, may re-dissolve, acted upon by venous blood, rich in carbonic acid; it accounts for the necessity of enamel for the teeth, the fluoride of calcium it contains protecting the osseous substance from the action of the carbonic acid discharged from the lungs, and dissolved by the saliva, which, besides being alkaline by this property, is the more fitted to neutralise this dangerous effect. May not the habitual use of Seltzer-water be serviceable in cases of gravel and calculi of phosphates of lime? In fine, is it not evident that bodies so extensive in organic nature as carbonic acid and phosphate of lime, ought to re-act upon each other under a crowd of circumstances, and give rise to very varied phenomena of solution and precipitation?—*Literary Gazette*, No. 1560.

ACTION OF OXALIC ACID.

A PAPER has been read to the British Association, "On the Action of Oxalic Acid upon the Blood and Dead Tissues of the Animal Body," by Dr. Letheby. It has been stated by Dr. Coindet, Dr. Christison, and others, that oxalic acid does not appear to have any corrosive action on the stomach like the mineral acids. Dr. Letheby, however, remarks that these statements are opposed to the observations which he has made. In every case which he had examined of poisoning by oxalic acid, the stomach after death was found to be so completely corroded that it would not hold together. Numerous experiments were made with various animal tissues, such as submitting skin, stomach intestine, muscle and tendon, to the action of oxalic acid of different strengths. After standing about twelve or fourteen hours at a temperature of 60° Fahrenheit, it was found that the cellular and mucous tissue of each underwent either complete solution, or else was so softened that it broke down under the pressure of the thumb and fingers; the albuminous and muscular tissues were also softened, and looked as if they had been scalded. The solutions were then filtered and evaporated in a water-bath; by which means a gelatinous-looking mass was obtained, and the oxalic acid had so entered into combination with the gelatine that it could not be dissolved out in its usual manner by the action of cold alcohol.—*Athenæum, No. 989.*

NEW MEANS FOR RENDERING SURGICAL OPERATIONS PAINLESS.

In the first week of January, 1847, the first experiment was made in England, of employing the inhalation of the vapour of Sulphuric Ether as a means of rendering Surgical Operations painless. The application is of American origin, and was first introduced, a few months previously, by Dr. Morton, a dentist, of Boston, U.S., by whom it was communicated to Dr. Boott, of Gower Street. By this gentleman, the discovery was described on the 17th of December, to Mr. Robinson, the surgeon-dentist, also of Gower Street; who, on the following day, operated upon a young lady thrown into sleep by the inhalation, during which a molar tooth was extracted from her lower jaw.

The inhalation occupied a minute and a half, and the patient's recovery from sleep another minute. Dr. Boott questioned her respecting the tooth, and she expressed her great surprise at finding that it was removed. She said that all she had felt was merely a sensation of cold around the tooth, a sensation which was caused, perhaps, by the coldness of the extracting instrument.

The apparatus employed consists of the lower part of Nooth's apparatus, with a flexible tube, to which are attached a ball-and-socket valve and mouthpiece, similar to those commonly used for inhalation; together with a nasal spring. It was first constructed by Mr. Hooper, of Pall Mall East.

The full effect of the vapour is produced in from one to two or three minutes generally, and, as soon as it is perceived, the operation is performed.

BORIC ACID.

M. Dumas has presented to the Paris Academy of Sciences, a communication from M. Larduel, on the mode of obtaining Boric Acid from the volcanic districts of Tuscany. The process consists in piercing openings by which jets of vapour escape; and forming round them reservoirs of water, in which the vapour is condensed. The saturated water is then evaporated by means of boiling, and the boric acid in the shape of crystals is dried, and becomes in a fit state for use. Until within the last twenty years, the operation was on a limited scale; for the purpose of evaporation, wood was used as fuel, and consequently the value of the produce was scarcely greater than the cost of production. The average quantity of boric acid was about fifty tons; it is now one thousand, for, instead of using wood for the boilers, the saturated water is kept in a state of ebullition by other streams of natural vapour. It is said that this industry has already produced a profit of ten millions of francs to Tuscany.

SPONTANEOUS NITRIFICATION.

From various facts adduced by Professor Schœnbein, he is led to the conclusion that, during the slow combustion of phosphorus in moist atmospheric air, while ozone is produced, there is also formed a quantity of nitric acid; and that in all cases where both these compound bodies are simultaneously generated, however different may be

the concomitant circumstances of the experiment, there is strong reason to suspect that the formation of the one is in some way connected with that of the other.

TINCTURE OF LOGWOOD AS A TEST FOR BICARBONATE OF LIME.

M. Dupasquier states that he employs Spirituous Tincture of Logwood to discover Bicarbonate of Lime in spring water. According to this chemist, the tincture should be prepared, either cold or with heat, with logwood recently cut and divided. The tincture has a brownish colour, and three or four drops being added, instantly communicates a fine violet colour to water which contains the least trace of bicarbonate of lime. In a water which contains any other salt of lime, it occasions only a pale yellowish colour.

Selenitic waters, containing bicarbonate of lime, give the former apppearance when cold; whereas after being boiled so as to decompose the last bicarbonate, the second reaction ensues from the sulphate of lime.

According to M. Dupasquier, the bicarbonate of lime, which is held in solution either in spring or river water, acts upon the colouring principle of the logwood in the same manner as the alkalies or the soluble neutral alkaline carbonates.—*Journ. de Chim. Méd.; Philosophical Magazine*, No. 196.

EXPERIMENTS ON COFFEE—CHLOROGENIC ACID.

M. Payen finds the composition of Coffee to be, approximately, as follows:—

Cellulose	34·000
Fatty substances	10 to 13·000
Glucose, dextrine, and an undetermined vegetable acid	15·500
Legumine, caseine (gluten)?	10·000
Chlorogenate of potash and caffeine	3·5 to 5·000
Azotized organic matter	3·000
Free caffeine	0·800
Concrete essential oil	0·001
Aromatic essential oil	0·001
Mineral bodies	6·997
Hygrometric moisture	12·000
	100·299

According to M. Payen, the formula of caffeine is $C_8\,H_{10}\,N_2\,O_3$. A part of the caffeine may be obtained directly, by treating the coffee first with ether and then with absolute alcohol: by afterwards treating it with alcohol of 0·60, several substances are separated, among which is a very important crystalline body, containing the remainder of the caffeine in a state of combination. These crystals are formed of a double salt, resulting from the combination of an organic acid (chlorogenic acid) with two bases; one of which is organic, and is caffeine; the other, mineral, is potash.

This natural salt of coffee is, then, a double chlorogenate of potash and caffeine: if it be rubbed after being dried at 212° on a sheet of *paper while hot, it is so* electrical as to adhere to the blade of a knife

presented to it, and remains attached to it in bulky elongated flocculi. When exposed to heat, it suffers no alteration from 212° F. up to about 300°; but when heated to about 365° F. it fuses, becomes of a fine yellow colour, boils and swells to five times its original volume, and it remains spongy, yellowish, solid and friable; when heated to 450° F. it becomes brownish, and is partially decomposed. The vapour which is disengaged yields, when condensed, acicular crystals of caffeine: it is scarcely soluble in anhydrous alcohol, even when heated; but a saturated boiling solution of 95 degrees, yields on cooling prismatic crystals radiating from a common centre; it is more soluble in alcohol of 85 degrees, and the crystallization is more abundant on cooling; the solubility always increases with the proportion of water: pure water dissolves still more, and a hot saturated solution becomes a mass on cooling. A cold solution, when slowly evaporated, gradually deposits a crown of very fine crystals in mammillated groups. The aqueous solution while crystallizing suffers more or less alteration by exposure to the air, and becomes yellow first, and afterwards greenish-brown.

Caffeine acts the part of a base in the composition of the natural double salt. This new compound exists in its original state in the perisperm of the coffee berry, from which it is readily extracted.

Among the curious properties of chlorogenic acid, the remarkable power which it possesses of developing a very intense green colour adds interest to the discovery of the crystallizable compound, which its rapid and valuable transformations have hitherto prevented from being observed.

M. Payen has likewise entered into many points, resulting from his analysis, to show that coffee slightly roasted is that which contains the maximum of aroma, weight, and nutrition. He does not hesitate to declare, that coffee is an eminently nutritive article, as it contains a large quantity of azote. He states that an infusion of coffee, in the proportion of one hundred grammes (rather more than three ounces) to a litre of water, contains twenty grammes of alimentary substance,—being three times as much as would be the case with an infusion of tea in the same proportion. He adds, that half a litre of coffee prepared as above, mixed with the same quantity of milk, and properly sweetened, is much more nutritive than double the quantity of soup (bouillon). M. Payen next enters upon a disquisition as to the qualities of chicory, an article so much used in France as a substitute for coffee, or as a means of adulterating that article. He refutes the received opinion of the wholesomeness of chicory as compared with coffee; and states that it is destitute of half the quantity of azote that is found in coffee, and is, therefore, only half as nutritive; whilst, in point of flavour and aroma, there is no comparison to be formed for an instant.

For further details, see the remainder of the paper, translated from *the Journal de Pharmacie*, in the Philosophical *Magazine*, No. 197.

PHYSIOLOGICAL ACTION OF THE ELEMENTS.

There has been read to the British Association, a paper 'On the Connexion between the Isomorphous Relations of the Elements and their Physiological Action,' by Mr. J. Blake. In a late communication to the Academy of Sciences at Paris, the author remarked, "that when introduced directly into the blood, the salts of the same base appear to exert the same effect on the animal economy." Since that time, further researches have led to the discovery of a law, equally interesting under a chemical as under a physiological point of view. The law alluded to is, that, when introduced into the blood, all isomorphous substances produce analogous effects, and give rise to the same reactions in the animal economy. This law has been verified by an extended series of experiments with the salts of magnesia, lime, manganese, iron, cobalt, nickel, zinc, cadmium, copper, bismuth, lead, baryta, strontia, soda, silver, potash, ammonia, palladium, platinum, osmium, iridium, antimony, the acids of phosphorus, arsenic, bromine, chlorine, iodine, sulphur, and selenium. One of the facts observed is, the connexion which exists between the physiological action of these substances, and their isomorphous relations to the elements of the blood. It is found that those substances which exist in the blood, or which have isomorphous relations with its elements, have the least marked reactions: thus, phosphoric and arsenic acids can be introduced into the veins without producing any marked phenomena; whilst, on the otherh and, those elements which are most distinct, in an isomorphous point of view, from the constituents of the blood, are those which give rise to the most marked phenomena. Two drams of arsenic acid injected into the veins will produce no marked effect on any organ; but a grain of chloride of palladium or two grains of nitrate of baryta are sufficient instantly to arrest the movements of the heart. Several other instances analogous to those quoted were pointed out.—*Athenæum*, No. 989.

PROGRESS OF EXPERIMENTS ON THE INFLUENCE OF LIGHT ON THE GROWTH OF PLANTS. BY R. HUNT.

Mr. Hunt's experiments, described in former communications to the British Association had all been confirmed by the results obtained during the past year. It had been found that seeds would not germinate if all the chemical rays were prevented from acting on them, and that the influence of the actinic or chemical rays was such that seeds germinated at a depth below the soil, under the influence of concentrated actinic force, acting on the surface, at which they would not have germinated under the natural conditions. The leaves being developed, the action of the luminous rays then became necessary to effect the decomposition of carbonic acid and the deposition of woody fibre within the plant. Under the joint influence of light and actinism, the plant arrived at maturity, and then the calorific, or heat-producing rays, were brought more fully into action to produce the ripening of fruit and the development of seed.

The paper gave rise to a long discussion, in which Dr. Dau-

beny, Prof. Grove, Mr. Prideaux, of Plymouth, and several other gentlemen, joined. It was shown that the inquiry was of the utmost importance, and that many of the results obtained were of considerable practical value. The condition of the solar rays at different seasons of the year, and also in different parts of the globe, was discussed, as well as the provisions regulating the distribution of plants under these influences shown. Some remarks of a more strictly philosophical nature, respecting the peculiar action of the rays as to their directive tendency, then followed.

THE ACTINOGRAPH.

MR. HUNT has reported to the British Association, a description of this instrument, which is employed for the purpose of registering the amount of chemical influence existing, at all periods of the day of year, in the solar rays. Many very important results had been obtained, which it was thought would go to show that many of the abnormal conditions of flowers, as, for instance, roses, which exhibited the formation of leaf-buds in the centre of the flower, were due to the action, or inaction, of those rays which have received the name of the actinic. It was found difficult to use this instrument in London; it was therefore proposed to transfer it to the Observatory of the Association at Kew.

DECOMPOSITION OF THE YELLOW AND RED FERROCYANIDES OF POTASSIUM BY SOLAR LIGHT. BY C. F. SCHŒNBEIN.

A SOLUTION of the yellow prussiate of potash kept in the dark does not change its colour, but when exposed to the action of solar light it becomes of a deeper yellow. To render that change very perceptible, a weak, *i. e.* nearly colourless, solution must be used, in which case the liquid will assume a yellow colour after having been acted upon by strong sunlight only for a few minutes. If the bottle containing the solution be closed and not quite filled with the liquid, an odour of prussic acid is perceptible, and at the same time a reddish yellow sediment subsides, which seems to be the peroxide of iron. The decomposition of the cyanide takes place much more rapidly when strips of filtering paper or linen are immersed in a solution of the salt, and exposed to the action of solar light. In a very short time, that part of the strip turned towards the sun becomes yellow, whilst the opposite remains colourless, or nearly so. If strips of paper moistened with the solution of the common prussiate of potash be closed up in a glass bottle containing air, they also turn yellow by exposure to the sun, and a strong smell of prussic acid is perceptible in the vessels after a short time. In the shade no such action takes place. A large piece of linen cloth drenched with a solution of the yellow salt, after having been exposed in the open air to the action of solar light for thirty-six hours, turned deeply yellow, and yielded, when treated with distilled water, a deep yellow solution, which on being filtered and heated to boiling became turbid, and deposited

flakes of peroxide of iron. The same solution exhibited a stronger alkaline reaction than the solution of the common prussiate does. From the facts stated, it appears that the yellow ferro-cyanide is decomposed by light into prussic acid, oxide of iron, and potash; and a compound is formed yielding with water a yellow solution. Is that compound carbonate of potash and peroxide of iron; and do the constituent gases of the atmosphere take part in the decomposition besides the solar light? Further experiments must answer those questions. A limpid solution of the red cyanide also becomes turbid when exposed to the action of solar light; prussic acid being evolved, and peroxide of iron thrown down.—*Philosophical Mag.*, No. 186.

INFLUENCE OF NITROUS ACID GAS ON VEGETATION. BY M. VOGEL, JUN.

It results from M. Vogel's experiments:—

1. That Nitrous Oxide is not favourable either to the Germination of Seed, or the Vegetation of Plants previously formed.

2. That this gas is not decomposed by the chlorophylle of plants, even when the apparatus is exposed to the direct rays of the sun.

3. That seeds which have remained for some time in this gas do not thereby lose the power of germinating in the air.—*Journ. de Pharm. et de Ch.; Philosophical Magazine*, No. 194.

VALUE OF DIFFERENT KINDS OF VEGETABLE FOOD.

Mr. E. N. Horsford has communicated to the *Philosophical Magazine*, No. 195, a paper of elaborate Analyses, showing the "Value of different kinds of Vegetable Food, based upon the amount of Nitrogen" which they contain. This valuable contribution occupies thirty pages, so that we can only give the author's results:

By comparing the results of the above investigation with each other, and with those previously known, the following conclusions have been arrived at:—

That the same species of cereal grain grown on different soils may yield unequal per-centages of nitrogen.

That one-seventh of fresh ripe cereal grains is moisture, which may be expelled at a temperature of 100° C. (212° F.)

That wheat and rye-flours, which to the eye and sense of feeling are undistinguishable from each other, may differ by from one to three-tenths of their whole quantity of nitrogen.

That root-crops grown on different soils may yield unequal per-centages of nitrogen.

That the per-centage of moisture in edible roots of the same species is, in the fresh condition, a constant quantity.

That beets, carrots, and turnips, have a larger per-centage of moisture than potatoes.

That the nutritive values of peas, beans, and lentils, correspond with each other.

That more aliment is contained in a given weight of peas, beans, or lentils, than in an equal weight of any other kind of vegetable food analysed.

That in several of the grains and roots analysed there are organic bodies beside those identical in composition with gluten and starch.

That the ashes of carrots, beets, turnips, and potatoes, as Prof. von Liebig has already remarked, contain carbonates.

That iron is present in the ashes of all the grains and roots analysed.

That the differences between the theoretical equivalents, as estimated from the per-centages of nitrogen and those ascertained by the experiments of

stock-growers, and particularly the differences between the results of the different stock-growers, may be attributed to the following reasons:—

Because the per-centages of nitrogen and carbon in fodder grown on different soils are unequal.

Because the prominent test has been the increase or diminution in weight of the animal fed. *Increase* in weight may arise from secretion of fat, derived from the sugar and starch of the plants. *Diminution* in weight may follow unusual activity, increasing the consumption of fat already present.

Because the experiments, in but few instances, were undertaken with substances whose per-centage of water and nitrogen had been ascertained.

Because theoretical equivalents have been employed in conditions unequally suited to digestion. The same food, coarse or fine, fresh or prepared for easy digestion, yields unequal measures of nutrition.

Because the conditions, whether exposed to the open air or protected in stalls, whether subjected to labour of uniform severity, or allowed the free range of pastures, have not been made alike.

Finally, because, as above intimated, some animals by nature differ greatly from others, in the facility with which fat and muscle are developed, even when the circumstances are precisely the same.

FUNCTIONS OF PLANTS.

Dr. Gardner, Member of the Lyceum of Natural History, gives the following summary of conclusions as fairly deducible from his Experiments:—

1. The epidermis of Plants, so far as experiments have been made, is porous, and permits the passage of gases according to physical laws.

2. The roots, during the existence of chemical changes in plants, absorb such gases from the soil-fluids as will indirectly satisfy the requisitions of the internal atmosphere.

3. The internal gas of plants fluctuates with the forces which operate on the plant: during the active state of the green vegetable it resembles a mixture of nitrogen 86·75, oxygen 13·25 per cent.; but at night, contains more oxygen and a proportion of carbonic acid.

4. The porosity of the entire plant is fully established by its action on artificial atmospheres.

Therefore, the physical structure of plants is that of a porous system subject to the laws of diffusion of gases, and endowed with no vitality other than the power of forming cytoblasts, and arranging cellules after a definite type.

ANALYTICAL INVESTIGATION OF THE POTATO DISEASE IN 1845.

Dr. Kemp has presented to the Cambridge Philosophical Society a paper, one of the objects of which is to shew, that, while Boussingault's analysis of the sound Potato may be expressed by an empirical formula representing the elements of proteine, starch, and cellulose, the analysis of the tuber, after undergoing the action of the late prevalent disease, admits of no such solution, but may be expressed by an empirical formula representing proteine, starch, and butyric acid, with a very large excess of the elements of water.

Butyric acid has been found in the diseased potato by Mr. Tilley; but the author's principal object is to connect the changes developed by his analyses with the researches of Erdmann, Marchand, and Schar-

ling, on the germination of seeds and tubers. These researches are totally independent and irrespective of the disease in question, whilst it is clear that the same changes occur in both cases. After reviewing the physical circumstances, with respect to soil and culture, which have proved remarkably favourable to the development of the morbid changes, the author arrives at the general conclusion that the disease in question essentially consists in an unnatural tendency to premature germination.

[For other investigations of the potato disease, see the Botanical Section of the present volume.]

EFFECT OF SULPHATE OF IRON UPON PLANTS.

M. CHEVALIER has by chance witnessed the action of water charged with sulphate of iron on different plants. A well, after having been fifteen years in the ordinary state, and the water good for plants, became ferruginous. The proprietor of the garden attributed the change to a chemical manufactory in the neighbourhood. Be this, however, as it may, M. Chevalier ascertained—1st, that the water of the well was charged with sulphate of iron; 2d, that in the soil in which the well was dug there was found a bed of iron pyrites (sulphuret of iron); 3d, that the proportion of sulphate of iron in the water was greater when the water was drawn in the greatest quantity; and, 4th, that the water of the neighbouring wells also contained sulphate of iron in solution, but in a less proportion. The result of the observations appears to have proved that certain plants have benefited, whilst others have suffered, by the use of this water. Among the former are shrubs in general, the *Daucus carotta*, *Allium porum*, *Brassica oleracea*, *Pastinaca sativa*; amongst the latter were the *Lactuca sativa*, *Phaseolus vulgaris*, *Cucumis melo*, *Zea maïs*, *Citrus aurantium*, *Amaranthus caudatus*, rose-trees, the *Dianthus cariophyllus*, *Cheiranthus annuus*, *Lactuca scariola*, *Punica granatum*, ranunculuses, geraniums, &c.

AGRICULTURAL CHEMISTRY.

PROF. DAUBENY has communicated to the British Association, a paper "On the Rationale of certain Practices employed in Agriculture," specifying, among the rest, the use of Quicklime and of Gypsum as fertilizers to the land. The former of these substances he supposes to act in part by rendering those inorganic substances which are present in the soil more soluble, or, in accordance with the views laid down by the author in a memoir which he has published in the Philosophical Transactions of last year, by converting the *dormant* constituents of the soil into active ones, or into a state in which they become immediately available. He appealed to the authority of Prof. Fuchs, confirmed by that of Mr. Prideaux, of Plymouth, as shewing that the alkali may be extracted from granite readily by water, after the rock *in a pounded form* has been heated, together with quicklime; *and he stated, that* a soil exhausted by long-continued cropping was

found by himself to yield to water twice as much alkali, after having been mixed with quicklime, as it had done before; hence the frequent application of lime tends to produce exhaustion in the land, not only because it supplies in itself no fresh alkali, but likewise because, by rendering that which the soil contains more soluble, it causes it to be washed away more readily by atmospheric water. Ploughing, and other mechanical methods of pulverizing the soil, appear to act in the same way; and so also may we suppose to do the sprinkling of the soil with sulphuric acid, as is practised in some parts of the Continent. The author then alluded to the various modes of explaining the advantage attributed to gypsum, which certain agricultural chemists had proposed: one ascribing its virtues to the direct influence of the salt; another to the indirect good resulting from it, owing to its property of fixing ammonia; a third regarding its acid constituent as of the principal utility; and a fourth, its base. Dr. Daubeny gave reasons for rejecting the third and fourth of these hypotheses, but considered that the use of gypsum may be in part attributable to the first, and in part to the second, of the causes pointed out. He supposes that this substance is generally useful to all plants, from its property of fixing ammonia, and also especially serviceable to certain species, by supplying them with a salt which they require for their development. He was principally anxious, however, to bring forward this subject, in the hope of inducing chemists to institute such experiments for the purpose of setting the question at rest.

A long discussion followed; several agricultural gentlemen remarking on the effects of carbonate of lime on wheat crops, and on the resulting weakness of the straw, owing to a deficiency of the silicate of potash necessary for the formation of the supporting epidermis of the grass. Some specimens of the disease in turnips, commonly called fingers-and-toes, were exhibited, and it was stated that the superphosphate of lime was a remedy for that disease. The Bishop of Norwich, however, remarked, that the cause assigned for this disease was not that to which he believed it must be attributed. The flow of the sap was checked by the action of an insect, and then an abnormal condition developed. This year, in many parts of the country, this and similar diseases were very prevalent; and the rev. prelate was disposed to regard the existence so abundantly of this insect as in some way connected with the electrical condition of the atmosphere during the exceedingly hot weather which had prevailed, producing the rapid decomposition of animal and vegetable matter.—*Athenæum*, No. 986.

TEST FOR GUANO.

In examining specimens offered for sale as Guano, it is desirable to have a ready test of sulphate of lime, by which it may be distinguished from the phosphate. The insolubility of the latter in water, and the *moderate* degree of solubility of the former, are certain criteria. Some time, however, is necessary to witness the effect in a satisfactory

manner. To obviate delay, Dr. Davy finds the following process to answer well. After well washing the sample under examination, to remove the more soluble salts, distilled or rain water is to be poured on the residue, and, a minute or two after, a few drops of the solution of oxalate of ammonia are to be added; if sulphate of lime be present, a cloudiness will be perceived apparently rising from the bottom, the cause of which requires no explanation.—*Jameson's Journal*, No. 81.

APPLICATION OF MANURES.

Mr. W. C. Spooner, a practical agriculturist, has explained to the British Association, "Certain Principles which obtain in the Application of Manures." Mr. Spooner pointed out that many of the recommendations of chemists were nearly valueless to the practical farmer, on account of the expense involved in the application. The use of sulphuric acid and silicate of potash were adduced as examples,—the expense in both cases rendering their use impossible, however valuable these ingredients may prove. Many other examples were given, enforcing on chemists the connecting with their experimental inquiries the practicability of their agricultural applications, both with reference to economical use and the ease with which they may be employed.

FUNGI IN AGRICULTURE.

Mr. Prideaux has read to the British Association, a paper on Fungi destructive in Agriculture. 1st. *Extent.*—Decandolle's theory of injurious excretions having been opposed by many arguments and experiments, particularly those recently published by Dr. Daubeny; that of Liebig, of specific exhaustion of the soil by plants of one species, leaving it fit for another which required different ingredients, had been generally substituted. Some, however, had taken a middle course, and supposed plants to breed animalcules, which they left in the soil, and which would feed upon other plants of the same species, but not upon those of different ones. The writer also, unsatisfied with the theory of specific exhaustion of inorganic ingredients, from the occasional unaccountable efficacy of ashes and soot, and the inconsistent effects of inorganic manures, had investigated the organic residues on the soil—after wheat, barley, turnips, and potatoes; compared them with the premature decay of wheat (where too often cultivated) in patches, expanding from centres, like fairy rings, and with the notoriety of fungus in the potato disease; and had thence been led to inquire how far such fungous parasites might be the general representatives of Decandolle's supposed injurious excretions. To what extent this may be true, the microscope will best decide, by examining the roots and contiguous soil of plants after harvest, especially those which have ripened seeds. 2nd. *Causes.*—Fungi and mucors were supposed to bear somewhat the same relation to vegetable, as mites and the like to animal, life—*a sort of* debased or degraded vitality, produced when *the organizing vital power* was not enough predominant over the *disorganizing tendency* to composition, to effect due assimilation of

the nutritious matter presented, but still sufficiently so to prevent decomposition or decay. The constant struggle between the organizing vital force and the decomposing power of chemistry was described; and instances were adduced to show that the invigoration of the vital force by solar light and abundance of proper nourishment, enabled it effectually to repass the decomposing action; whilst, on the contrary, gloom, warm, damp, and stagnant electrical air, assisted the disorganizing force, and often produced predatory fungi, which might thus be considered a sort of retarded disorganization. So, ripening plants, as their vital powers decay, might generate such parasites; which would explain how they weaken the soil so much more than green crops, in proportion to the contents of their ashes. Such fungi, though not the cause of disease or decay, are effectual promoters of both, and probably the *chief* means of infection, where that also exists. 3rd. *Remedies.*—If further investigation prove fungi thus generated to produce such generally injurious effects, the remedies will be of practical importance. These should be cheap and antiseptic, as well as destructive to fungi. Sulphate of copper with salt, which had been successfully used for seed patatoes, was too costly for spreading over the soil. Fresh lime, the general destroyer of noxious vermin, roots, and seeds, would probably answer till rendered inert by carbonic acid. Salt, which appeared more promising, Mr. Prideaux had found, in same experiments, rather promote than destroy fungi. Lime and salt digested together would eliminate caustic soda, a very active destroyer; and soda ash, with or without lime, would have a similar effect, and ammoniacal gas liquor is perhaps a still more destructive application. But none of these alkalies can be regarded as antiseptic; the ammonia, when neutralized in the soil, might even promote disorganizing fermentation, when already too strong: and therefore, though they might do after seed crops, more antiseptic dressing must be used where there is putrescent tendency. Chloride of lime, in solution, he had found useless on diseased potatoes: the powder had been said to answer better, but either would soon be rendered inactive in the soil by the humous matters. Sulphuric acid diluted might succeed where farmers had the means of applying it; and alum, which is of easy application, is a cheap and powerful antiseptic. Dressings of this kind, intended to kill the fungi, and check the disorganizing action, would be turned under in the first ploughing after harvest, independent of the usual manure for nourishing and exciting vital action.—*Athenæum*, No. 988.

FAIRY-RINGS OF PASTURES.

PROF. J. T. WRAY has described to the British Association, these patches, with which most persons are familiar. It was stated that the grass of which such rings are formed is always the first to vegetate in the spring, and keeps the lead of the ordinary grass of the pastures till the period of cutting. If the grass of these fairy-rings be examined in the spring and early summer, it will be found to conceal a number of agarics, or "toad stools," of various sizes. They are found situated

either entirely on the outside of the ring, or on the outer border of the grass which composes it. Decandolle's theory,—that these rings increased by the excretions of these fungi being favourable for the growth of grass, but injurious to their own subsequent development on the same spot,—was remarked on, and shewn to be insufficient to explain the phenomena. A chemical examination of some fungi (the true St. George's Agaric of Clusius—*Agaric graveolens*) which grew in the fairy-rings on the pasture around the College at Cirencester, was made. They contained 87·46 per cent. of water, and 12·54 per cent. of dry matter. The ashes of these were found to contain—

Silica	1·09
Lime	1·35
Magnesia	2·20
Peroxide of Iron	a trace.
Sulphuric Acid	1·93
Carbonic Acid	3·80
Phosphoric Acid	29·49
Potash	55·10
Soda	3·32
Chloride of Sodium	0·41
	98·69

The abundance of phosphoric acid and potash, existing, no doubt, as the tribasic phosphate of potash ($3\,KO,\ PO_5$), which is found in these ashes, is most remarkable. The author's view of the formation of these rings is as follows:—A fungus is developed on a single spot of ground, sheds its seed, and dies; on the spot where it grew, it leaves a valuable manuring of phosphoric acid and alkalies, some magnesia, and a little sulphate of lime. Another fungus might undoubtedly grow upon the same spot again; but, upon the death of the first, the ground becomes occupied by a vigorous crop of grass rising like a phœnix on the ashes of its predecessor. It would thus appear that the increase of these fairy-rings is due to the large quantity of phosphated alkali, magnesia, &c., secreted by these fungi; and, whilst they are extending themselves in search of the additional food which they require, they leave, on decaying, a most abundant crop of nutriment for the grass.—*Athenæum*, No. 986.

CHEMICAL CONSTITUTION OF CALCAREOUS CORALS.

In the work on Zoophytes, by J. Dana, geologist of the United States' Exploring Expedition, are some valuable researches on this subject, with tables of analyses, which show, that, contrary to the expectation when the research was commenced, the fluorine is present in much larger proportion than phosphoric acid. The silica exists in the Coral in its soluble modification, and probably is united to the lime. The free magnesia existed as carbonate, and was thrown down as caustic magnesia by the lime-water. Some small portion of lime was probably thrown down as carbonate, in spite of every precaution to the contrary. Only in two or three instances, however, was there any effervescence on the addition of chlorohydric acid to redissolve it

It need hardly be said that the existence in sea-water of all the matters noted in these analyses is a just inference.

COMPARATIVE NUTRITIVE POWERS OF GREEN AND DRY FODDER FOR CATTLE.

A COMMUNICATION has been made to the Paris Academy of Sciences, by M. Boussingault, on the Comparative Nutritive Powers of Green and Dry Fodder for Cattle. Hitherto, the received opinion was, that natural or artificial grasses, on their being converted into hay, lost a portion of their virtues. To determine the point, M. Boussingault fed a heifer alternately, for ten days at a time, upon green or dry food, and weighed the animal after each ten days. He found no difference in the average weights; and therefore comes to the conclusion, that the hay made from any given quantity of natural or artificial grass has the same nutrition as the quantity of green food from which it is made.—*Athenæum*, No. 968.

Dr. R. D. Thomson has communicated to the British Association, a summary of his Report to Parliament on Feeding Cattle, and of his own published papers and works, shewing the principles upon which dietaries should be constructed so as to meet the wants of the animal system under the particular circumstances in which it may be placed, either when vegetable food is alone used, or when it is desirable to employ also animal food.

In regard to the discussion recently carried on between Liebig and Boussingault, (accounts of which have from time to time been published,) Dr. Thomson states that the oil contained in the food is by no means sufficient in amount to afford a source for animal fat. —*Literary Gazette*, No. 1552.

EXPERIMENTS ON THE YOLK OF EGGS. BY M. GOBLEY.

THE author remarks, that a German chemist of the name of John was the first who carefully examined the Yolk of the Egg; the chemists who preceded him regarding it merely as consisting of water, albumen, oil, gelatine, and colouring matter. John concluded from his experiments, published in 1811, that the yolk of egg was composed of water, a sweet yellow oil, traces of free acid, which he presumed to be the phosphoric, a small quantity of reddish-brown matter, soluble in æther and in alcohol, gelatin, much of a modified albuminous substance, and sulphur.

In 1825, Prout found the yolk to be composed of 54 water, 17 albumen, and 29 oil; and that it contained besides sulphur, phosphorus, the chlorides of sodium and potassium, the carbonates of potash and soda, lime and magnesia, partly in the state of carbonates.

Chevreul was of opinion that the orange colouring matter of the yolk was due to the combination of two colouring principles; one yellow, approximating that of the bile; and the other red, resembling that of the blood.

Lastly, in 1829, M. Lecanu discovered in the oil of the egg, a fat

crystallizable, unsaponifiable matter, which he considered to be cholesterine.

Such, says M. Gobley, was the state of our knowledge respecting the yolk of the egg when he began his experiments: he states that the substances which he obtained from the yolk are:—1. Water. 2. Albuminous matter or vitelline. 3. Oleine. 4. Margarine. 5. Cholesterine. 6. Margaric acid. 7. Oleic acid. 8. A peculiar acid containing phosphorus, which is in fact phosphoglyceric acid. 9. Lactic acid and extract of meat. 10. Various salts, as chloride of sodium, chloride of potassium, hydrochlorate of ammonia, sulphate of potash, phosphate of lime, and phosphate of magnesia. 11. Yellow and red colouring matter. 12. Azotized organic matter, which does not appear to be albumen. The oleic, margaric, and phosphoglyceric acids appear, in the author's opinion, to be combined with ammonia.

In the opinion of Berzelius, the yolk of egg contains some volatile fatty acids, on account of the facility with which the yolk becomes rancid; M. Gobley has not been able to discover them, nor any gelatine, and sulphur was met with only in the albuminous matter. —*Journ. de Pharm. et de Ch.*; *Philosophical Magazine*, No. 185.

POISONOUS FISH.

Sir W. Burnett, M.D., has communicated to the Royal Society, a Report which he has lately received from Mr. Jameson, the surgeon of the flag-ship at the Cape of Good Hope, of the rapidly fatal consequences ensuing from eating small portions of the liver of a fish, known at the Cape by the name of the *Bladder* or *Toad Fish*, the *Aptodactylus punctatus*, or *Tetrodon* of Cuvier. The symptoms were chiefly pain and burning sensation at the epigastrium, constriction and spasm of the fauces and muscles of deglutition, rigidity of the tendons, coma, paralysis and convulsions, following one another in quick succession, and terminating in death within twenty minutes after the poisonous food had been taken. Several other instances of the same kind are next related; and a narative is subjoined of the case of a seaman who lost his life with similar symptoms, from the bite of a water-snake in Madras roads; the *Coluber laticaudatus* in Linnæus (*Hydrus colubrinus* of Shaw); and also of a ship's company who were also severely affected by eating portions of a large *Banacuda*, (*Perca major*).

The author ascribes the symptoms induced by these deleterious substances to their action on the nervous system alone; there being evidence of congestion only, but not of inflammation, in the stomach and other viscera.

OBSERVATIONS ON YEST.

M. F. W. Ludersdorff, in order to decide the question whether Yest be an organized substance, and whether, if it be, it occasions fermentation *in consequence of* it, made the following experiments:—He *triturated a portion of it* on glass so perfectly, that the microscope *could not detect any* kind of globular texture; two parts of grape-

sugar were dissolved each in ten parts of distilled water; one of them was mixed with the triturated yest, and the other with a similar portion of the same yest not triturated; both were exposed to a temperature of 95° F. The liquid containing the untriturated yest began to ferment in half an hour, and the action continued uninterruptedly for two days, when all the sugar was decomposed; but the liquid containing the triturated and disorganized yest did not yield the smallest bubble of gas during the whole of the time.—*Journ. de Pharm. et de Ch.*; *Philosophical Magazine*, *No.* 194.

ANALYSIS OF TOBACCO.

M. BARRAL has read to the Paris Academy of Sciences, the results of his Analysis of twelve sorts of Tobacco. With the exception of the roots, the quantity of oxygen found in the ashes of the leaves, stalks, and fibres, averages 13 per cent. The quantity of azote is very large, the average in the leaf being 5 to 6 per cent. There is also 10 per cent. of a colourless oil. The juice obtained by macerating the leaf in water is strongly acidulated. Vauquelin attributes this to the presence of malic acid; but M. Barral, having crystallized it, proves that the acid is one peculiar to the plant, and he gives to it the name of *nicotic*. He shows that this nicotic acid occupies an important place in the family of organic acids, and bears the same relation to macetonic acid as oxalic acid does to acetic. Tobacco also contains an essence which has hitherto been obtained only in very minute quantities. M. Barral has isolated the nicotianine, and studied all its properties. It is an azotized substance, which, being distilled with potass, gives the nicotine, a powerful alkali, and an energetic poison.

DISEASES FROM THE IMMODERATE USE OF TOBACCO.

DR. LAYCOCK has explained to the British Association, that the diseased action from the continuous and immoderate use of Tobacco is observed to pervade the mucous membranes of the digestive and respiratory systems, producing congestive inflammation of the fauces and stomach; and of the nares, frontal sinuses, larynx, and bronchial lining of the lungs. Gastritis, with the symptoms of aggravated indigestion and hæmoptœ, were among the worst results of these affections; but it was found in many cases to produce disease of the circulating organs and of the nervous system—weakening the force and regularity of the heart's action, and diminishing the intellectual and moral powers. In conclusion, Dr. Laycock read a Report from Dr. Wright, confirming his own observations, and containing experiments demonstrating the physiological action of the drug on animals.

DIGESTION OF ALCOHOLIC LIQUIDS.

MM. BOUCHADAT and SANDRAS have completed their series of communications on the Digestion of food, by an article on the effect of Alcoholic Liquids. They state that these liquids do not undergo in the process of digestion any other change than that of being weakened by the gastric juice and mucus, the saliva, and the other

liquids which may be present. The absorption of alcoholic liquids is effected by the orifices of the veins. It is particularly in the stomach that this takes place, when these liquids are taken in excess or mixed with sugar. The absorption, however, may be continued throughout the intestines. The chyliferous vessels perform no part in this absorption. Spirituous liquors, when introduced into the circulation, are not eliminated by any of the secretory organs; a small portion only is evaporated by the lungs. If the quantity taken be very great, the arterial blood preserves the colour of venous blood, and alcohol may induce apoplexy. Alcohol, under the influence of oxygen, incessantly introduced into the system by the respiration, may be immediately converted into water and carbonic acid, but in many cases acetic acid has been obtained.

ANHYDROUS ALCOHOL.

M. CASORIA proposes to employ perfectly dry sulphate of copper to render Alcohol anhydrous, and also to employ it as a test for ascertaining that it is perfectly free from water. For these purposes, he saturated alcohol, of 83° by the instrument of Gay-Lussac, with fused chloride of calcium: he distilled one-third of the liquid, and to about 7500 grains he added a small quantity of the anhydrous sulphate, and kept the mixture in a well-closed bottle which was shaken occasionally. The salt, by combining the water of the alcohol, resumes its blue colour, and fresh portions of the salt are to be added till the blue colour ceases to be produced: the alcohol after distillation may then be considered anhydrous.

To determine the absence of water from alcohol, a small quantity of dry sulphate of copper is to be put into a glass tube and the alcohol poured upon it: if no colour be generated, the alcohol may be regarded as anhydrous. In performing this experiment it is requisite to keep the tube closed, as the moisture of the atmosphere would interfere with the accuracy of the result.—*Journ. de Chim. Med.*; *Philosophical Magazine*, No. 196.

BOTANY BAY RESIN.

DR. STENHOUSE has analysed this remarkable Resin, which is known in commerce as the yellow gum or acaroid resin of Botany Bay, and which exudes from the *Xanthorœa hastilis*, a tree which grows abundantly in New Holland, especially in the neighbourhood of Sydney.

The quantity of carbazotic acid which this resin yields when treated with nitric acid is so great, and it is so easily purified, that this resin seems likely to prove the best source of that substance. When the resin is subjected to destructive distillation in an iron or copper retort, it yields a very large quantity of a heavy acid oil mixed with a very small quantity of a neutral oil, which is lighter than water. If, however, the resin have been previously digested with alkaline lyes, so as to remove all the cinnamic and benzoic acids it contains, the heavy oil is obtained as before, but none of the light essential oil. The acid oil is readily soluble in potash and soda lyes; in its smell and properties

it resembles creosote; when it is digested with nitric acid, it is wholly converted into carbazotic acid; and when a slip of fir-wood is dipped in it, and then moistened with either muriatic or nitric acid, the deep blue colour passing quickly into brown, so characteristic of hydrate of phenyle, is immediately produced, with which substance the oil appears completely identical. The light oil above mentioned, the quantity of which is extremely small, is separated from the hydrate of phenyle by saturating it with an alkali, and distilling the mixture in a glass retort with a gentle heat. In smell and properties it resembles benzine, and is most probably a mixture of benzine and cinnamene.—*Philosophical Magazine*, No. 189.

ANCIENT BLACK VARNISH OF GRECIAN AND ETRUSCAN POTTERY.

DR. DAVY remarks, in *Jameson's Journal*, No. 81:—"When Indian corn (maize) is exposed to the fire, it is easily charred, but it is reduced to ashes with extreme difficulty; indeed, it may be said that the charcoal of this grain is almost incombustible. It owes this property to the large proportion of phosphate of magnesia it contains in conjunction with a little phosphate of lime. This is proved by digesting it with dilute nitric acid. The acid dissolves these salts, and after their removal the charcoal is incinerated without difficulty."

Owing to its property of resisting the fire, it has occurred to Dr. Davy that this glazed charcoal may be advantageously employed as a varnish for pottery. It has the properties, in the most essential respects, of the admired black varnish of the pottery of ancient Greece and Etruria; and Dr. Davy apprehends its effect would be as pleasing to the eye as a red ground, and that it would be equally durable. The Doctor hopes it may have a trial.

COLOURING MATTERS.

THERE has been read to the British Association, a Report, by Dr. Schunk, on Colouring Matters.

The author, in the first instance, directed his attention to Madder, because, he says, the colouring matters contained in it are almost unknown, or rather worse than unknown: namely, known in such a manner as surely to mislead; and because madder is of such importance to the art of dyeing that every discovery in relation to it acquires immediately a practical bearing. Alizarin, discovered by Robiquet, is doubtless the most interesting, and the most definite in its nature, of all the substances contained in madder. Many assert that it is a product of decomposition; Robiquet states that it pre-exists in the plant. This Dr. Schunk affirms, as he obtained it in more than one way, without the intervention of heat; he has also obtained from madder two other colouring matters. Madder, treated with hot or cold water, with muriatic or sulphuric acid added, yields a dark reddish brown flocculent precipitate. This was separated by filtration, and washed until the acid was removed. Treated with boiling water, part of it dissolves, with a brown colour; and a few drops of acid added to the filtered solution, throw down a dark-brown pre-

cipitate. This Dr. Schunk considers a peculiar colouring matter, similar in its properties to orcein, hematin, and other soluble colouring matters. It dissolves red in alkalies, and imparts very lively colours to mordanted cloths. The author is not aware that this substance has been hitherto described, but he, as yet, has only very slightly examined it. The residue of the above process, treated with dilute boiling nitric acid, acquires a bright yellow colour and a more powdery consistence. This yellow powder contains all the alizarin of the root, but mixed with another substance of an amorphous nature, though of very similar properties, and difficult to separate. The only successful method of many tried by the author, was to dissolve the yellow powder in a little caustic potash; and to add perchloride of iron, which produces a dark reddish brown precipitate, consisting of peroxide of iron in combination with the two substances. Boiling this precipitate with an excess of perchloride of iron, the alizarate of iron dissolves, forming a dark-brown solution, while the iron compound of the other substance remains behind, and may be decomposed by treating with perchloride of iron and muriatic acid, and washing till all the oxide of iron be removed. It seems, the author says, also to be a colouring matter, as it dissolves with a red colour in alkalies, and gives red compounds with the earths and metallic oxides: it is insoluble in water, but soluble in alcohol, with a yellow colour. It therefore resembles the resins in its general properties. It cannot be obtained in a crystallized state. From a hot concentrated solution in alcohol, it separates, on cooling, as a yellow powder. It imparts no colour to mordanted cloth.—*Literary Gazette*, No. 1552.

NEW SUBSTANCE FROM COCHINEAL.

Mr. Warren De la Rue has described to the Chemical Society, a new body which he had obtained from Cochineal by the following means:—The colouring principle being first separated from an infusion of cochineal, the mother-liquor is to be carefully evaporated in a water-bath to the consistence of a syrup, when there appears floating in it a small quantity of granular chalky-like masses, which, being collected on a filter, is kept warm, and, when drained, well washed with cold water: they are then dissolved in boiling water, and recrystallized: again well washed, and finally dissolved in as small a quantity of boiling water as possible; a little animal charcoal is to be added, and the ebullition continued for a short time. On filtration and cooling, the new body crystallizes as a bulky assemblage of tufts, filling the vessels. On drying, they form into paper-like masses, of a perfectly white colour, and a beautiful silky lustre.

This body is sparingly soluble in cold water; considerably more so in hot water; soluble in ammonia, from which it crystallizes as the ammonia is driven off by heat; it is likewise soluble in acids.

From the process pursued in separating this substance from cochineal, there is *no doubt* that it pre-exists, and is not produced by the *operation; it may, however*, be a product of oxidation of some part of *the insect during its* preparation for commerce. Three hundred parts

of cochineal yield one part of the new body.—*Abridged from the Philosophical Magazine*, No. 192.

TYRIAN PURPLE.

M. Bizio, of Venice, in a communication to the Paris Academy of Sciences, has shewn this famed dye to be contained in the *Murex Brandaris;* the amethyst purple in the *Murex Trunculus;*—two shells which are very abundant on the shores of the Mediterranean. The liquid is contained in a large bag, which is situated at the upper part of the animal, and may be extracted with great facility. All that is necessary is to break the shell with a hammer, and express the liquid from the bag by means of a spatula. The Roman dyers break the shells in their oil mills. The liquid, which is white and milky in the bag, oxidizes in contact with the air and light, and passes through all the shades of green to a more or less deep red.—*Mechanics' Magazine.*

TEST OF INDIGO.

M. Fritsche, of St. Petersburgh, has communicated to M. Chevreul, the following method of testing the value of Commercial Indigo:—Take 1 part of commercial indigo and 1 part of grape sugar, and place them in a flask capable of containing 40 parts of liquid; fill half the flask with hot alcohol, and then add 1½ parts of strong liquid caustic soda to another equal portion of alcohol, and fill up the flask with them. The flask thus filled is to be allowed to remain at rest until it becomes clear. The fluid is then withdrawn, by means of a syphon, into another flask. This liquid is first yellow, but, by exposure to the air, it changes to red, violet, and blue, depositing microscopical crystals, which are larger in proportion to the gradual admission of the oxygen of the air, and consist of pure indigo. They are then thrown on a filter, and washed rapidly with hot water, in order to remove a substance produced by the action of the soda on the sugar, which is insoluble in alcohol, but soluble in hot water. From 4 ounces of inferior indigo of commerce, M. Fritsche obtained, by the first infusion, 2 ounces of pure indigo blue; a second infusion of the residue gave only a dram of indigo.—*Mechanics' Magazine*, No. 1172.

INDIAN COBALT.

A new field of Cobalt has been discovered in the East Indies, in the mountainous country of Rajpootanah, a district already celebrated for its mineral wealth, and principally for its coppers in the state of sulphur and sulphate, and its alums. It is in one of the copper mines that this cobalt is found, lying abundantly in the state of sulphur of great purity. It is accompanied by only one other substance—pyrites of iron, highly magnetic, and easily separated from it by a loadstone of moderate power. These it contains in the proportion of 9·22 per cent. The remainder of the mineral consists

wholly of pyrites of cobalt, of the specific weight of 5·45, and composition following:—Cobalt 64·64; sulphur 35·36. The Indian jewellers already use it advantageously for colouring gold with a rose tint of great delicacy.—*Athenæum*, No. 987.

ARTIFICIAL ULTRAMARINE.

TILL within the last twelve or fifteen years, Ultramarine was made with *lapis lazuli*, and sold as high as fifteen guineas per ounce. Since the mode of making it artificially was discovered, its price has fallen to a few shillings per ounce. It is manufactured to a great extent upon the Continent; but, we believe, has not yet been made in Great Britain. The process of Robiquet, published in 1833, is the best which scientific chemists possess, though, undoubtedly, the manufacturers have greatly improved upon it. Robiquet's process consists in heating to a low redness a mixture of one part porcelain clay, one and a half sulphur, and one and a half parts anhydrous carbonate of soda, either in an earthenware retort or covered crucible, so long as vapours are given off. When opened, the crucible usually contains a spongy mass of a deep blue colour, containing more or less ultramarine mixed with the excess of sulphur employed, and some unaltered clay and soda. The soluble matter is removed by washing, and the ultramarine separated from the other impurities by levigation. It is to be regretted, however, that the results of Robiquet's process are by no means uniform; one time it yields a good deal of ultramarine of excellent quality; and, perhaps, at the very next repetition of the process in circumstances apparently similar, very little ultramarine is obtained, and that of an inferior quality.*

ARTIFICIAL AVENTURINE.

MM. FREMY and CLEMANDOT have presented to the Paris Academy of Sciences, samples of Artificial Aventurine, the fabrication of which hitherto has remained a secret with the glass-blowers of Venice. Fine specimens are rare, and fetch a high price. The process, after numerous experiments adopted by MM. Fremy and Clemandot, gives results which promise that aventurine may be made in all glasshouses. After having unsuccessfully tried the action of different metals on glass coloured by the oxide of copper, they were led to examine the reduction that the oxides with the minimum of oxidation exercised on the protoxide of copper, and chiefly that of the protoxide of iron of the forges: under influence of heat, the oxide of this iron readily reduced the protoxide of copper to metallic copper, and produced a metallic oxide (the peroxide of iron) soluble in glass, and giving to it a slightly yellowish tint. Heating then for twelve hours a mixture of 300 parts of pounded glass, 40 parts of protoxide of copper, and 80 of the oxide of iron, they have obtained a glass containing abundantly crystals of metallic copper. If, therefore, the difficulty of manufacturing aven-

* *Guimet's process for forming* Artificial Ultramarine will be found in the *"Arcana of Science," 1829*, p. 86; Robiquet's process, in the "Arcana of *Science," 1834, p. 143.*

turine is to produce a glass filled with brilliant crystals of copper uniformly distributed, the problem is completely solved. The specimens submitted were somewhat opaque; but, compared with the Venetian aventurine, the copper of both was observed with a good microscope to be crystallised in regular octohedrons. Thus, this aventurine appears the same as that of Venice.

GOLDEN YELLOW COLOUR.

M. Guimet gives the following receipt for making a yellow colour of a golden tint much more intense than the well-known Naples yellow. Take of antinomiate of potass (carefully washed) one part, and of minium two parts, grind, and mix them well into a paste; then dry the paste, and reduce it to a powder; and, lastly, expose the powder for four or five hours to a red heat, taking care not to raise the temperature so high as to disengage the oxygen from the lead and antimony.

IMPROVED PHOTOGRAPHIC PROCESSES.

The following are the most striking results of the past year:—

Application of New Compounds.—Mr. Bingham, Chemical Assistant in the laboratory at the London Institution, to obviate the deposition of moisture upon the plate during the time it is exposed to the bromine vapour, has employed the bromide of lime, a compound of bromine with limes analogous to bleaching powder (chloride of lime), strewed over the bottom of the pan. The great advantage of this compound is, that it may be used continuously for a fortnight without renewal; and, unlike bromine water, its action is unaffected by the ordinary changes of temperature. The process will be found detailed in the *Philosophical Magazine*, No. 194.

Theory of Photographic Action.—Mr. Nott has illustrated, to the Society of Arts, the connexion between the photographic agent and electricity; he has also experimented upon the results produced by light polarized into the camera by a double reflection from the plane of the picture; from the parallel glass he found that the objects in deep shadow, and those in sun-light, were taken down simultaneously, and with equal precision; and that without the slightest trace of solarization, exhibiting a sunlight view of the greatest truth and beauty, in which the transparency of the shadows, and the effect of the distance produced by an exquisite gradation of tint, such as art could scarcely hope to imitate. The result of polarized light seems doubly interesting since the recent and beautiful discovery of Faraday, where a ray of extinguished polarized light is re-illumined by electricity. The process will be found further detailed in a report in the *Mechanics' Magazine*, No. 1173.

M. Claudet, in opposition to Mr. Nott, contends, (in a paper read to the Society of Arts), that the rays of light are the agent; he had made many experiments on forming pictures by reflexion, but had not been able to discover any essential difference betwixt them and such as are formed by the direct ray. His next series of experi-

ments regarded the photographic qualities of light of different colours. Blue proved to be the most powerful photographic agent; and yellow the weakest. One of the most beautiful experiments by which this was proved, consisted in throwing the prismatic spectrum on paper and on the silver plate; the colours being marked on the paper, and the effect remaining on the photographic plate. He thus showed that the photographic prism presents effects very different from the apparent intensity of the prismatic spectra. A specimen was shown of a silver plate, on which the rays of light had brought out a powerful picture without the action of mercury. Another series of experiments made was on the photographic action of the moon, which had formed a powerful picture by five minutes' exposure. He hoped to be able to obtain an accurate Daguerréotype of the moon's surface drawn by herself on a silver plate.—(*See Year-book of Facts*, 1846, p. 207.)

Representations by Starlight have since been produced: the subject, black lace; the lines on the plate covered by the network having been protected from the action of the starlight, whilst the exposed interspaces were being *stellarised*. The stellar is not so defined as the lunar photograph of black lace, in a beautiful specimen; owing to the many angles at which the light from the several stars reaches the plate; but the effect is amply sufficient to prove that starlight possesses photogenic properties.

Application of Ammonia.—M. de Nothomb has communicated to the Paris Academy of Sciences, a paper on the use of Ammonia in the preparation of plates for photographic impressions. Hitherto, it had been considered important to carry on the process of photography in places as free as possible from ammoniacal emanations. M. de Nothomb is of quite a different opinion. He says, nothing tends so much to increase the rapidity of the operation as the use of ammonia. After preparing his plate in the usual way, with the vapour of iodine, &c., he exposes it to the vapour of a solution of ammonia; and, at the end of twenty or thirty seconds, it is, according to his account, in a much better state than it would otherwise be, to receive the impression that is required in the camera obscura.—*Athenæum*, No. 974.

Copies of Paintings.—Among the more complete results is the union of photography and painting, or the production of a finished miniature retaining the accuracy and tint of the Talbotype, the tone and shadows being greatly improved. M. Mansion, the artist associated with M. Claudet, has recently made farther progress in the application of the solar picture to aid the more ancient art. The metallic hue of the Daguerréotype, and the not much more agreeable brown colour of the Talbotype, have been, and are, the principal objections to these wonderful works of nature. The miniature-painting above referred to, on the photography itself, was intended to remove this objection, and with great success; but the colour was still brown. By the new method, the truthfulness of the Talbotype is maintained, and the colour of life given to the portrait. The outlines are most accurately traced on a material invented by M. Mansion,

and upon it he then paints a likeness. The specimens shewn to us—copies of landscapes, and of men and horses—were most minute resemblances. With a similar view, M. Claudet has been experimenting on Fizeau's process of etching Daguerréotypes. Some of the impressions are exceedingly distinct, and the lights and shades as marked as in the ordinary engraving. In the fainter prints, however,—and the fainter the better for this purpose—the likeness is sufficiently clear for M. Mansion to paint it to the life. So now, any one may have a painted fac-simile of a Talbotype, or a coloured impression of a Daguerréotype.—*Literary Gazette*, No. 1512.

Improved Focus.—Messrs. Belfield, Lefevre, and Foucault, have presented to the Academy of Sciences at Paris, an essay on this improvement of the Daguerréotype process. Hitherto, they say, the merely iodized plates have not been efficient, wherever the diverse portions of the one view or object to be represented possess notably different intensities of illumination; and thus, by the previous process, the different portions of the plate could not come out with the tone corresponding with the respective intensity of illumination. One or other inconvenience will arise: either the artist has to stop for giving merely to the lighter parts their adequate strength, or the operation must be prolonged, and then the lighter portions of the image will be confused, and what is technically called burnt *(brulées)*. The method of Messrs. Belfield and Lefevre consists in the use of iodine and brome. The plate is polished and iodized as usual, and then made to absorb (by the usual process) vapours of brome, three times the amount which has been considered hitherto the maximum of the susceptibility of such plates. While the usual quantity of brome will not change much the appearance of the iodized plates, that recommended by Messrs. B. and L. will make them assume a somewhat darkish blue, or violet colour. Plates thus prepared will give an image, perfectly complete and detailed, of objects even presenting the greatest variety of tones. The treble quantity of *brome* is *essential*, but it must also not be exceeded; as otherwise, the plate could scarcely condense the mercury, and the image would be less clear.

Beard's Improvements.—Mr. Beard has considerably improved his process, by the introduction of colour, which is uniform and so transparent, as not to affect the likeness in any degree. Mr. Beard has also succeeded in making an arrangement by which a Daguerréotype may be reproduced either of increased or of less size—hitherto, a difficulty.

"GUN COTTON."

THE discovery of this new explosive power has excited extraordinary interest throughout Europe; and, as its preparation is protected by patent, and was, consequently, for a time, secret, the variety of manipulatory surmises have been too numerous to be chronicled in our pages. Indeed, in the statements of the many claimants of the invention, and the multiplicity of analogous processes which have been published, it would not be difficult to find materials for a tolerably sized volume. From this abundance it will be comparativ

easy to select such portions of the statements as shall present to our readers an approximation to a history of the discovery.

Origin.—"Gun Cotton" was first announced by Professor Schœnbein, the discoverer of ozone; and a specimen was first shown by him to the Natural History Society of Basle. It is, to all appearance, common cotton wool, both as seen by the naked eye and under a lens. Prof. Schœnbein described it as cotton prepared by a secret process; and by applying heat, caused it to explode with a pale, white, silvery flame, with but little smoke, and equally small residue: it was also stated to possess double the projectile force of gunpowder, and common balls and shells were experimentally projected by it. Next, the Professor made an interesting experiment on the wall of an old castle: it had been calculated that from three to four pounds of gunpowder would be requisite to destroy this wall, and a hole capable of containing that quantity was prepared. In this aperture were put four ounces of the prepared cotton, which, when fired, blew the massive wall to pieces. Again, the sixteenth part of an ounce of the prepared cotton, placed in a gun, carried a ball with such force that it perforated two planks at the distance of fifty-eight paces; and, at another time, with the same charge and distance, drove a bullet into a wall to the depth of 3½ inches. In other experiments, a dram of cotton sent a ball, three-quarters of an ounce weight, to a distance of two hundred paces, where it penetrated a deal plank to the depth of two inches. A portion of this cotton, when thrown into water, and afterwards dried, did not lose its inflammable property. Such were the experiments made by the discoverer, in Switzerland.

Introduction into England.—In September last, Prof. Schœnbein attended the Meeting of the British Association, at Southampton; and the fame of the gun cotton having travelled much faster than the Professor, great was the curiosity of the members of the Association to witness the operation of this new power. At one of the evening meetings, its properties were explained and experimented with by Professor Grove. The explosive force was stated to be double that of gunpowder, yet the substance left no soil on fire-arms. There are two qualities of the gun cotton: the second-best causing little smoke, the other none. Gunpowder explodes at 600° of heat; gun cotton at 400°; yet it may be exploded on gunpowder without the powder igniting.

Mr. Grove first exploded a small quantity of gunpowder, for the purpose of showing the large quantity of smoke it evolved. He then fired a small lock of the gun cotton, of the second quality; it flashed off as rapidly as gunpowder, and but a very small quantity of smoke was perceptible; the paper on which it exploded being but slightly stained. The best quality of gun cotton exploded still more rapidly, without any smoke whatever; and it gave out an orange-coloured flame.

Mr. Grove next steeped a piece of the cotton in a glass of water, and then pressed it and dried it between blotting-paper; and though it could *not have been thoroughly* dry in the time, the cotton flashed *off when heated wire* was applied to it, and without any perceptible *smoke. The flash,* however, was not, in this case, so instantaneous *as that of the perfectly* dry cotton.

The last experiment was the explosion of a piece of the gun cotton placed upon loose gunpowder, without firing the latter. This was perfectly successful, though the cotton must be quite dry to insure its success; for, if the combustion be less rapid, the gunpowder will explode.

These experiments were witnessed by his Royal Highness Prince Albert, who was present at the meeting, and was elected an honorary member of the Association.

As Professor Schœnbein came to England with the view of patenting his discovery, he did not divulge the secret of the preparation to his brother *savans* at the Southampton Meeting.

Other Claimants.—Scarcely had Schœnbein announced his discovery at Southampton, when there appeared, almost simultaneously, three or four inventions of similar explosive agents. M. Bœttger, of Frankfort, discovered one; and Dr. Otto, Professor of Chemistry, in Brunswick, relying on an observation of Pelouze, contained in the 136th page of Professor Otto's *Manual of Chemistry*, has succeeded in producing an exploding cotton. We quote the Doctor's own account of the invention:—

"In the preparation of the exploding cotton, common, well-cleaned cotton, is dipped for about half a minute in highly concentrated nitric acid, (the acid which I use being made by the distillation of ten parts of dried saltpetre, and six of oil of vitriol,) and then instantly placed in water, which must be often renewed, in order to free the cotton from the acid with which it is impregnated. Care must then be taken that all the knotty parts be properly disentangled, and that it be thoroughly dried. After this, the explosive cotton will be ready for use. Its effects create astonishment in all who witness them: the smallest portion, when struck on an anvil, with a hammer, explodes like fulminating powder; when kindled with a glowing body, it takes fire like gunpowder; and when used in a gun, its operation, though in a far greater proportion to its weight, is precisely the same as that of gunpowder. This gun cotton is employed in the same way as gunpowder: a piece of it is rammed down the barrel, then a bit of wadding, and after that a ball; a copper cap ignites and explodes the cotton." Dr. Otto's statement is accompanied by a testimonial, and he adds: "without a single exception, all who have witnessed my experiments have been most completely satisfied."

The Editor of the *Pharmaceutical Times* has prepared cotton according to Professor Otto's directions, but has found it to acquire a fulminating property by no means so great as described:

The method is by steeping cotton for half a minute in nitric acid, and then drying it: "on adding, however, (says the Editor,) sulphuric acid to the nitric acid, then proceeding as before, the result was different; and a cotton was obtained which possessed all the properties of fulmination and capability of disruption and projection stated by Prof. Schœnbein. We were induced to try the effect of mixing sulphuric acid with nitric, from a consideration of the remarkable affinity which the former acid evinces for water, thus concentrating the nitric acid to its maximum.

"Prepared by the process we have indicated, gun cotton resembles, to some extent, the ordinary material; but, in some cases, it assumes a slightly yellow colour. It explodes by the percussion or friction of iron against iron, or any metal of similar hardness, and also when exposed to a temperature of 400° Fahrenheit,—circumstances to be borne in mind in the application of this cotton to the purposes of fire-arms."

Two other claimants remain to be noticed. M. Morel, the engi- neer, at Paris, has produced "a fulminating matter, having all t appearance of cotton and wadding, which he has tried in the pres

of General Gourgaud, President of the Committee of Artillery; Colonel Piobert, Member of the Academy of Sciences; and several other officers. The following details of the experiments are from the *Messager*, Paris paper:—

"Burned on the hand, it causes no sensible pain, leaves no stain, and produces no smoke. Dipped in water and pressed, and afterwards dried between two leaves of blotting-paper, it preserves its fulminating properties. General Gourgaud fired a charge of fulminating cotton from an ordinary fowling-piece, at a distance of forty yards from the object at which he aimed. He fired a holster pistol at a distance of twenty-five yards, and a pocket pistol at a distance of ten yards. At forty yards, a ball from the fowling-piece traversed a plank of beech of 0·35 centimètres thickness; at twenty-five yards, the ball from the holster pistol lodged in the plank without perforating it; the ball from the pocket pistol made the same impression on the plank as that which might have been produced by a charge of ordinary gunpowder. The charge of fulminating cotton leaves scarcely any residue in the barrel. The recoil of the gun is extremely slight, and the report is not louder than that of a large detonating cap.

"M. Chodsko, a Polish refugee, likewise presented a fulminating substance, which has the appearance of cotton, and which was tried with an artillery musketoon, fired at forty yards. The ball produced the same effect as that fired by fulminating cotton, but it left a considerable deposit in the barrel. The cotton powder of M. Chodsko was compressed into a wadding in order to charge the gun, whilst the fulminating cotton was not. Both materials ignite by the blow of a hammer on an anvil, but not by the blow of a hammer on wood."

Experiments with Fire-Arms;—

"Having tried the effects of this cotton as a projectile agent for small arms," (says the Editor of the *Pharmaceutical Times*,) "its relative agency in propelling a ball would appear to be about equal to the finest sporting gunpowder, than which it occupies more space in a gun, on account of its lighter specific gravity,—a fact which must not be lost sight of."

The writer then examines the circumstances of using the cotton for small fire-arms, and finds three difficulties: 1. the chance of the fibres getting between the ramrod and barrel, and thus prematurely exploding; 2. if the barrel be considerably heated by continuous firings, the cotton may explode, even without friction, and its use, from this cause, would be impossible in many cases of actual service; 3. the doubt whether the cotton will find its way into the chamber or contracted breeching of a gun, spontaneously, like gunpowder; lastly, the property which this remarkable body possesses of not soiling a piece, would render it, *cæteris paribus*, invaluable; but this, the writer fears, is not the case.

Some projectile experiments have likewise been made in the grounds of Mr. Barron, at Stanmore, with fowling-pieces and rifles. Thus, as reported in the *Athenæum*, a gun charged with 30 grains of prepared cotton, propelled an equal charge of shot, with greater force and precision, at a distance of forty yards, than was done with the same gun loaded with a hundred and twenty grains of gunpowder. A rifle, charged with fifty-four and a half grains of gunpowder, sent a ball through seven boards, half an inch in thickness, at a distance of forty yards; the same rifle, charged with forty grains of gun-cotton, propelled the ball into the eighth board. Another rifle, which had been used for elephant shooting, and consequently carried a much larger ball, charged with forty grains

of gun cotton, propelled the ball through eight boards, at a distance of ninety yards. In no case was the discharge accompanied by a greater recoil than usual; and the reports were not louder than those accompanying the discharge of guns and rifles loaded with gunpowder.

We may here quote the opinion of Mr. Greener, the author of the celebrated work on "The Gun," who considers that, "save for very limited purposes, this discovery can never benefit the human race, and is certain to cause many lamentable accidents; no gun ever made will long withstand its use, if quantity be employed, as the intensity of its velocity brings it on a perfect similarity with the fulminating compounds; these will carry small projectiles with great velocity a given distance, but to obtain an extended range is impossible, with safety; its application to cannon will (if very great caution is not used) be the means of destroying many valuable lives; for sufficiently do I feel conversant with the subject to affirm, that there is not a gun in Her Majesty's service but would burst if charged with anything like the same weight as is used of gunpowder, and under no circumstances will an extreme range be obtainable."

Mining Experiments.—The advantages attendant upon the use of gun cotton for blasting, in mines, must, we think, be very great; since the smoke proceeding from the coarse gunpowder, used for this purpose, occasions so much annoyance, and injury to the health of the miners. Some interesting experiments have been detailed to the Cornwall Geological Society, by Mr. R. Taylor, in whose presence they were made by Schœnbein. The first took place in a granite quarry, near Penryn. Two holes were prepared; the quarrymen weighed out the quantity of powder required to charge one hole, which was one quarter of that weight of the cotton. The first hole (said Mr. Taylor) was fired, and produced its effect completely; the "cotton" hole was fired, and tore the rock to fragments—in fact, doing more than was required, the charge being too great. The iron mine of Restormel was selected for another experiment. From its being in hard ground, and having the adit level driven a considerable distance into the hill, the end of that level was very close, and presented great difficulty in the escape of the smoke of gunpowder. They first tried an experiment in the extreme end of the adit level, six or seven hundred fathoms from the entrance. The miners prepared two holes, which on being fired with the cotton tore the ground, when the miners said it was quite satisfactory, and that had powder been used they could not have gone into the place for three-quarters of an hour; but (says Mr. Taylor) we went in instantly, and experienced no inconvenience whatever, except from the safety fuse, and that was no inconvenience to the men.

Experiments have also been made in the Ardwick Lime Pits, near Manchester, when it was found, after several trials, that 222 grains of gun cotton produced a better effect than 4 ounces, or 1,750 grains, of the usual gunpowder employed in mining operation; so that we may safely estimate the power of the gun cotton as eight times stronger than gunpowder.

The greater cost of the gun cotton will, however, prevent its being substituted for gunpowder in mining; it being nearly three times the price.

English Patent.—Mr. Thomas Taylor, the chemist, has patented an explosive compound analogous to gun cotton, and has published the following formula for preparing the explosive cotton. Mix in any convenient glass vessel 1½ oz. by measure of nitric acid (of the specific gravity of 1·45 to 1·50) with an equal quantity of sulphuric acid (sp. gr. 1·80). When the mixture has cooled, place 100 grains of fine cotton-wool in a Wedgewood mortar; pour the acid over it, and with a glass rod imbue the cotton as quickly as possible with the acid. As soon as the cotton is completely saturated, pour off the acid, and with the aid of a pestle quickly squeeze out as much of the acid from the cotton as possible. Throw the mass into a basin full of water, and thoroughly wash it either in successive portions of water, or under a tap, until the cotton has not the slightest acid taste. Finally, squeeze it in a linen cloth, and dry it in a water-bath. Mr. Taylor states that two grains and a half of a rather inferior cotton projected a bullet from a two-grooved rifle through a deal board an inch thick, at a distance of seventy feet. This process is only recommended by Mr. Taylor as a modification of Dr. Otto's; "it has the advantage, however, of being much cheaper, and more easily managed. The strong acid used by him is not only very expensive, but is rarely to be met with, while sulphuric acid and common nitric acid are very cheap, and may be procured anywhere. So simple is the process, that sufficient cotton may be prepared to exhibit all its characteristic properties in the course of ten minutes; and if this substance ever come into practical use, the sportsman might prepare his stock of powder just before he started."

French Experiments.—MM. Suzanne and Des Mezières have reported to the Paris Academy of Sciences, the following results from six samples of gun cotton, prepared by successively varying the quantity and state of the acids, &c.

Taking the average of the results furnished by the six samples thus manufactured, under not very favourable circumstances, 5 grammes of gun-cotton produce the same effect upon a musket-ball as 13 or 14 grammes of powder in an ordinary musket.

To sum up, under the head of manufacture: in order to obtain a good result, it is necessary—

1. To steep purified cotton in a mixture composed of equal parts of azotic and sulphuric acid.
2. The duration of the immersion appears unimportant; it may, however, be stated, that the best samples had been steeped from 10 to 15 minutes.
3. A mixture may be used in which cotton has been already immersed, reviving it if necessary.
4. The cotton must not pass beyond the level of the liquid.
5. The cotton should be dried slowly, and not be subjected, especially when it is still damp, to a temperature exceeding 100 degrees.
6. By washing it in water saturated with saltpetre, its power is a little increased; but it is not thought that this process is worth the additional expense.

The advantages are—its cleanliness; the rapid combustion and non-residue; the absence of any bad smell; its lightness; the possibility of handling it without danger, at a distance from the fire, of course; the absence of dust, &c.; and an indisputable force, which may be estimated henceforth at triple that of gunpowder of equal weight.

The disadvantages are, bulk, increased inflammability, and the disadvantage of evolving vapour during its explosion: it *wets* the guns and cannon just as gunpowder *fouls* them.

Analysis.—Mr. E. F. Teschemacher and Mr. R. Porrett have found gun cotton to consist very uniformly of nitric acid and lignum, in the proportion of 60 of the former to 40 of the latter. Properly exploded in a narrow glass tube, so as to collect the gaseous product, 52·33 grains of the cotton were found to give 100 cubic inches of gas, of which the composition was rather remarkable. It consisted of—

Carbonic acid	14·286,	or 2 vols.
Cyanogen	7·143	„ 1 „
Nitric oxide	35·715	„ 5 „
Carbonic oxide	35·715	„ 5 „
Nitrogen	7·143	„ 1 „
	100·000	

Besides which, a sublimate of oxalic acid appeared, and a considerable quantity of water was formed in the combustion.

A remarkable property of the gun cotton is, that, when exposed to a temperature of from 200 to 300, or if kept at the latter temperature for a short time, the cotton becomes brown, and loses its property of explosion; but, if thrown into a vessel heated to 350, it immediately explodes. Steaming it, as calico-printers steam their cloth, has no effect upon it; if any, its efficacy is increased. The acids used (equal mixtures of nitric and sulphuric acids) should be as strong as can be made, and only in such proportion as will wet the cotton employed. This is the most difficult part of the operation, and requires dexterity in the management, as the cotton is apt to take fire, unless it be speedily saturated with the acids. This circumstance, it is feared, will prove a practical difficulty in the manufacture of the article on a large scale.

Action upon Polarized Light.—Dr. Inman, of Liverpool, states, in a letter to the *Times*:—If small portions of ordinary and prepared cotton be examined microscopically with transmitted light, no marked difference can be detected between them; but, if we use an object-glass of an inch or half-inch focal distance, and add a polarizing apparatus to the instrument, a great alteration is at once perceptible. The fibres of ordinary cotton will now be seen brilliantly illuminated and coloured on a dark ground; while those of the prepared substance are dark, colourless, and almost invisible at every half turn of the prism. This phenomenon is still more striking when flax is used instead of cotton. The larger fibres of this substance form naturally very beautiful objects with polarized light, each appearing like bright rows of variegated transparent glass; but, when they have been subjected to the action of the acid, they become dull, yellow, and opaque, and without the slightest play of colour.

The Electricity of Gun-cotton has already been recorded at page 156 of the present volume.

Identity with Xyloïdine.—On Nov. 2, M. Pelouze observed to the Paris Academy of Sciences, that the properties which M. Schœnbein assigns to his gun-cotton can only apply to xyloïdine. He adds :—"M. Dumas, as well as myself, made this remark in the origin of the first communications of M. Schœnbein. Reasoning on the hypothesis that the *poudre-coton* is nothing else than xyloïdine, I may be permitted to say a few words with respect to its history, and of some of its properties. Xyloïdine was discovered in 1833 by M. Braconnot, of Nancy. He prepared it by dissolving starch and some other organic substances in nitric acid, and precipitating these solutions in water. In a note inserted in the *Comptes rendus de l'Académie des Sciences en* 1838, I shewed that the xyloïdine resulted from the union of the elements of the nitric acid with those of the starch, and explained, by this composition, the excessive combustibility of the substance produced. I ascertained—and this, I think, is a very important result in the history of the application of xyloïdine—that, instead of preparing it by dissolving the cellulose, it might be obtained with infinitely greater facility and economy by simply impregnating with concentrated nitric acid, paper, cotton, and hemp; and that these organic matters thus treated took fire at 180 degrees, and burnt almost without residuum, and with excessive energy; but I think it right to add, that I never for an instant had an idea of their use as a substitute for gunpowder. The merit of this application belongs entirely to M. Schœnbein. Eight years ago, however, I prepared an inflammable paper by plunging it into concentrated nitric acid. After leaving it there for twenty minutes, I washed it in a large quantity of water, and dried it in a gentle heat. I have recently tried this paper in a pistol; and, with about 3 grains, pierced a plank two centimètres in thickness (about ¾ of an inch) at a distance of 25 mètres."

Nevertheless, Prof. Schœnbein's originality is established upon two points: first, whatever else his gun cotton may be, it is not exactly the xyloïdine of Pelouze: this is soluble in acetic acid; the gun cotton of Schœnbein is not acted on at all by that acid.—(*Letter to the Times, by Dr Schœnbein*). In the second place, the application is his own; M. Pelouze specially stating that he never entertained the idea of xyloïdine being used as gunpowder.

It should be added, that all ligneous substances may be made explosive by means analogous to those of preparing cotton; and sawdust, flax, hemp, tow, and paper, have been thus prepared. Attempts have already been made to furnish theories, more or less ingenious, on the composition of the cotton powder, by explaining the chemical combinations which may be effected in its preparation. What appears certain is, that the cotton undergoes a complete transformation of its elements, although retaining its ordinary appearance.

Natural History.

ZOOLOGY.

HOMOLOGIES OF THE "TEMPORAL" HUMAN BONES.

PROF. OWEN has read to the British Association, a paper "On the Homologies of the Bones collectively called 'temporal' in Human Anatomy." The author commenced by referring to the definition of the term "*homology*," as contra-distinguished from "*analogy*," given in the glossary in the "Lectures on Invertebrata," 8vo. 1843; the sense in which it is there used signifying things or parts which are of the same essential nature, whatever different forms or names they may bear in different animal bodies. Thus, the fore-limb of the *Draco volans*, being composed of essentially the same parts as the wing of the *bird*, is *homologous* with it; but the wing of the *draco*, being composed of different parts, viz. the ribs and skin, is not homologous, but is analogous to the wing of the bird, as having a similar relation of function. Prof. Owen gave several other instances of "homology" and "analogy," and proceeded to define the different kinds of "homology." The widest relation of homology is that in which a part or series of parts stands to the fundamental vertebrate type of organization: thus, when the "mastoid" process of the temporal bone of Anthropotomy is said to be "the parapophysis of the parietal vertebra," its *general* homology is enunciated. When it is said to repeat, in its vertebra, or natural segment of the skeleton, the par-occipital of the occipital vertebra, and the post-frontal of the frontal vertebra, its *serial* homology is indicated, just as when we say that the radius in the arm answers to the tibia in the leg, one rib to another, in the successive series of skeleton-segments. When the essential correspondence of the mastoid process of the temporal in man with the distinct bone called "mastoid" by Cuvier, and "temporal" by Spix and Agassiz, in the skull of a fish, is shown, its *special* homology is determined. In the present communication, Prof. Owen proposed to consider the *general*, *serial*, and *special* homologies of the parts which, from their peculiar mutual confluence in man, have been termed collectively the "temporal bone" in human anatomy.—For the details, see the Report in the *Athenæum*, No. 986.

NEW SIGN OF DEATH.

THE following discovery may be of great service in cases of suspected Death. The communication was lately made to the Paris Academy of Sciences, by M. Ripault, who, in directing the attention of members to the discovery, observed, that it consisted in perfect flaccidity *of the iris* when the globe of the eye is compressed in two opposite *directions*. If the individual be living, the pupil retains its circular *form*, notwithstanding the compression; if dead, the aperture becomes *irregular*, and the circular form is lost.

VERTEBRATE STRUCTURE OF THE SKULL.

One of the most valuable papers read to the Zoological Section of the British Association, is that "On the Vertebrate Structure of the Skull," by Prof. Owen. Prof. Owen commenced by referring to his previous definition of a typical vertebra, or primary segment of the endo-skeleton. He considered that the bones of the skull consisted of a series of four such segments. Homologists differed as to the number of cranial vertebræ; and the skull might differ, like the neck, the back, and other regions in different animals, as to the number of its vertebral segments; but Prof. Owen had not seen good evidence of a greater or less number than four, in which he agreed with Bajanus. He enumerated these segments in a direction contrary to those of the trunk; because, like the vertebræ of the tail, they lose their typical character as they recede from the trunk, the chief condition of these terminal modifications being the circumstance of the contained nervous axis shrinking and receding centripetally at both its ends. He retained for the cranial vertebræ the names applied to them, in conformity with those given by the anthropotomist to their neural spines, viz. *occipital*, *parietal*, *montal*, *nasal*; the upper or neural arches of each he termed respectively *epencephalic*, *mesencephalic*, *prosencephalic*, and *rhinencephalic*; the lower or hæmal arches were the *scapular*, the *hyoidean*, the *mandibular*, the *maxillary*; the diverging appendages of these hæmal arches are respectively the *pectoral*, the *branchiostegal*, the *opercular*, and the *pterygoid*; the maxillary arch likewise supporting, in higher vertebrata, a *zygomatic* appendage, for its more complete fixation.

The special homology of the pectoral fins of fishes with the fore-limbs of quadrupeds was indicated by Aristotle, and first definitely pointed out in later times by Artedi. Geoffroy St.-Hilaire had devoted special memoirs to the determination of the bones of the pectoral fins, but had no knowledge of the primary homology of the pectoral fin as the radiated appendage of the inferior arch of a cranial vertebra, or of its serial homology with the branchiostegal and opercular fins. He consequently spoke of the junction of the scapular arch to the cranium as something very strange. Ohm's latest published idea of the essential nature of the arms and legs is, that they are no other than "liberated ribs." Carus, in his ingenious endeavours to gain a view of the primary homologies of the locomotive members, sees in their several joints repetitions of vertebral bodies—vertebræ of the third degree. But Prof. Owen remarked that such transcendental analyses sublimated all differences, and definite knowledge escaped through the unwarrantable extension of the meaning of terms. He recognised a vertebra as a natural group of bones forming a primary segment of the skeleton; in each segment he also recognised a centrum, a neural arch, a hæmal arch, with sometimes diverging appendages; each of these were parts of a vertebra, and each different parts. To call them all "vertebræ" was to abdicate the power of appreciating and expressing their differential and subordinate characters. With regard to the term "rib," though it might be given to each moiety of the hæmal

arch of a vertebra, Prof. Owen would restrict it to that part of such arch to which the term "vertebral rib" is commonly applied; but, admitting the wider application, yet the bony diverging and backward projecting appendage of such rib or arch was a different thing from the part supporting it. Arms and legs might be developments of costal appendages, but were not the ribs themselves liberated; although liberated ribs might perform analogous functions, as in the serpents and draco volans.

Prof. Agassiz regarded this paper as one of the most important contributions to philosophical anatomy that had hitherto been adduced. The Professor objected to two points, adding, if Prof. Owen was right, then much of the anatomy of the osseous system of the lower animals must be done over again.—*Abridged from the Athenæum*, No. 987.

CURE OF STAMMERING.

A PAPER has been received by the Paris Academy of Science, from M. Serres, on the means of the Cure of Stammering. M. Serres recommends the equalization of pronunciation, viz.: a deliberate enunciation of each syllable, a firm determination in the stammerer to conquer the defect, and the aid of muscular action. The two first-mentioned means have, we believe, been tried with success in many cases; the third appears to have something like novelty, as regards, at least, the explanation given of the effect of gesticulation. He says, "As the action of intelligence will not always suffice for the regular enunciations of syllables, the stammerer must have recourse to the motion of the hand or any other part of the body. If it is necessary to raise the voice and cause it to undergo inflections and modulations, gesticulation, which becomes a sort of pedal, will aid in the accomplishment of this physiological function; for the action will ascend to the chest, and assist or moderate the muscular action of the thorax."

WHITE RACE OF THE AURES, (MONS AURARIUS) IN THE PROVINCE OF CONSTANTINE, ALGERIA.

M. GUYON took the opportunity of the expedition lately made by the French army in the Aurès, to collect new information regarding this variety of the human species, which has been described by the travellers Peyssonel, Bruce, and Shaw. "It is quite certain," says M. Guyon, "that in the Aurès there are men having a white skin, blue eyes, and fair hair. The son of the Sheik of the beautiful and rich valley of Oued-Adji, a young man who was frequently in communication with our camp at Bathna, situated at a short distance from the foot of these mountains, presents a remarkable example of this race. The Whites of the Aurès do not form distinct tribes; but, while they predominate in certain tribes, are very rare in others. They are very numerous in the small town of Menna, which *is situated to* the south of the valley of Sidi-Nadji, near the town of *Khanga;* and still more so in the tribe of the Mouchavas, who spoke *a language* in which, according to some, certain Teutonic words can

e recognised. The Whites of the Aurès are of a middle size; they orm alliances with the Kabyles and the Arabs, although rarely; and hey are considered as rather lukewarm observers of the Koran: so hat, in this respect, the Arabs esteem them less than they do the Kabyles. The latter say, that they have inhabited the country for a ery long time; and that they maintained their position at a period when others of their countrymen, who lived in the neighbouring parts of Africa, were expelled. The Whites of the Aurès are always pretty numerous at Constantine; and they there follow the trade of baker, of butcher, or of bath-heater, just as the Mozabites, who are inhabitants of Southern Algeria, do at Algiers. The notice of M. Guyon is concluded by a disquisition on certain passages of ancient authors, upon which some modern writers have supported the opinion, that the Whites of the Aurès are the remains of the Vandals who were expelled by Belisarius.—*Comptes Rendus*; *Jameson's Journal, No.* 88.

THE SMALLEST "MATURE" HEAD.

MR. JAMES STRATTON, of Aberdeen, says, in the *Phrenological Journal* for September—"Having been favoured (Feb. 7th, 1846) with a deliberate examination of that "man in miniature," Master Charles S. Stratton, the individual called in the advertisements, "General Tom Thumb," I found him to be a great curiosity, on account of the size of his head. His age was stated to be fourteen years, and I have much reason to believe the statement to be correct. Judging from external appearances, the bone and integuments are slightly thinner than in the average of male heads; I, therefore, estimate these at twenty-six, the average being thirty, cubic inches. This deducted from the entire side of the head, leaves forty cubic inches as that of the brain, being the smallest recorded human brain capable of sane and somewhat vigorous mental manifestation; for such does the possessor exhibit. My previous researches for the smallest head, at or above seven years of age, the period at which, according to the erroneous statements of Tiedemann, Hamilton, the Wenzels, and others, the human brain attains its full size, are stated, in my "Contributions to the Mathematics of Phrenology," as follow:—"After ten years' practice in observation, during which I have measured more than 3000 heads, and formed an eye-estimate of more than ten times that number, measuring every head in any way remarkable to which I could obtain access, I have to report the following as unique, in my experience, in the respective classes to which they belong. Mr. L——, a gentleman of talents and learning, size of head 111 cubic inches; C. A——, aged sixty, a village orator, politician, wit, poet, and tinker, a little above 100; Robert Duncan, aged twenty-nine, found employed in a large manufactory, ninety-two; and Robert Gibson, a pauper found in a public soup-kitchen, size of head, eighty-two inches." "General Tom Thumb" is a very favourable specimen in most particulars. The anterior and coronal regions are slightly below an equal balance. The cerebellum seems to be very small, as defective, indeed, as I have ever seen it in an

infant of six months. In this particular, the "General" is a very remarkable case against the doctrine held by some, that the cerebellum is connected with the regulation of muscular action; for if there be any one thing more than another, for which he can be said to be remarkable, apart from his diminutive size and fine porportions, it is his control over muscular action; his system having attained a degree of firmness, strength, and maturity, quite equal to, or rather beyond, the average of his age. He is, in short, a case of unusual interest to the phrenological world. He affords the extremely rare opportunity of solving one question in the great problem: What amount of manifestation is a well-balanced and healthy head of a given size capable of presenting? He is certainly very near, if he does not actually touch, the extreme lowest point on the scale of size. What, then, is a head of sixty-six, or a brain of forty cubic inches, capable of attaining in his circumstances?"

PRINCIPLE OF VITAL AFFINITY.

DR. ALISON has communicated to the Royal Society of Edinburgh, a valuable paper on this investigation, which he concludes as follows: —Oxygen, in its elementary state, although indispensable to all living action,—although a condition of vitality equally universal as heat,—yet hardly enters, if it enter at all, into any of the combinations which are due to the vital affinities. Although taken into the interior of every living being, it appears to comport itself there almost, if not entirely, as it does in acting on dead matter. The expression of Liebig, that the action of the oxygen of the air in living bodies is *destructive*, is perhaps fitted to convey an erroneous idea; but we are certain that its chief, if not its sole, action in the animal economy, is on those portions of matter which have no vital properties; either because they are redundant—not required for the nourishment of the tissues,—or because they have been re-absorbed from them, having lost their vital affinities; and with these it unites, only to carry them off in the excretions, particularly in the great excretion by the lungs. We now know that the speculation as to the connection of the oxygen of the air with vital action, long and ably maintained by the late Mr. Ellis, viz., that its sole use is to dissolve and carry off excreted carbon, and therefore that in the bodies of animals it goes no farther than the lungs, was erroneous; but we may assert with much confidence, that it goes no farther than the circulating blood; and that, although its action there is essential to all the metamorphoses which are there accomplished, yet all the combinations into which it actually enters are destined to immediate separation from the living body,—being, in fact, the media by which all living bodies, at all periods of their existence, are continually resolving themselves into the inanimate elements from which they sprung. This principle will be better illustrated, however, by a review of the leading facts lately ascertained as to the formation of the other compounds peculiar to organized bodies, and the excretions of animals.

MECHANISM OF RESPIRATION.

A PAPER has been read to the Royal Society, "On the Mechanism of Respiration," by Francis Sibson, Esq. This paper was almost entirely occupied with anatomical details collected from an extensive series of dissections of the muscles and bones concerned in the act of respiration, in man and the lower animals, for the purposes of elucidating the mechanism of their action, both in inspiration and in expiration; accompanied by a number of illustrative diagrams and drawings.

The author commences with the serpent tribes, which present the simplest form of ribs; being attached only at their vertebral ends, while their anterior ends are free. When these ribs are brought forward by the action of the levatores costarum and external intercostal muscles, the chest is expanded; and when drawn backwards by the long depressers, internal intercostals and transversales, expiration is effected.

In birds, there are added to the former apparatus a sternum, and a series of sternal ribs, the respiratory movements of which are performed in directions the reverse of those of the vertebral ribs. During inspiration, the angles between the vertebral and sternal ribs become more open; the sternum moves forwards, and the spinal column slightly backwards, by the combined action of the scaleni and sterno-costal muscles on the first vetebral and first sternal ribs respectively; of the levatores costarum and external intercostal on all the lower vertebral ribs, and of the sternal intercostals on all the lower sternal ribs. On expiration, these movements are reversed by the action of the internal intercostals, the external and internal oblique, recti, transversales, and other muscles.

The mechanism in the mammalia is further assisted and modified by the addition of a large and powerful diaphragm. The thoracic ribs are articulated with the sternum by the medium of cartilages, corresponding to the sternal ribs of birds: those ribs which are connected with the inferior curve of the dorsal arch, have floating cartilages, and may be considered as a diaphragmatic set of ribs. When raised, the former approach each other, and the latter recede from each other anteriorly. Intermediate to these are the longer ribs connected with the dorsal arch, having their cartilages united and articulated with the lower end of the sternum. The scaleni muscles invariably act during the whole time of inspiration. The external intercostals, between the thoracic ribs, are also throughout inspiratory; but those portions which are situated between their cartilages are expiratory; and those between the diaphragmatic ribs are inspiratory behind, expiratory to the side and in front, and inspiratory between their cartilages. Between the intermediate ribs, they are for the most part slightly inspiratory between the ribs and expiratory in front, between the cartilages. The external intercostals of the thoracic ribs are expiratory behind, inspiratory in front, if the ribs approach there, and are inspiratory between their costal cartilages. Between the diaphragmatic and intermediate set of ribs, and between their cartilages, they are throughout expiratory. The levatores costarum draw the posterior por-

tions of the lower ribs backwards. In the ass and the dog, the upper fasciculi of the serratus magnus are expiratory, the lower inspiratory, and the intermediate neutral. In man, the greater part of the fasciculi of this muscle is expiratory. In the ass, the lower fibres of the serratus posticus inferior are inspiratory, and the upper fibres expiratory. In the dog and in man all are throughout expiratory.

MUSCULARITY OF THE IRIS.

PROFESSOR MAUNOIR, of Geneva, has communicated to the Royal Society, a paper on this subject. The author has satisfied himself, from the result of his own dissections, as well as from the concurrent testimony of a great number of anatomists, that the Iris is provided with two sets of muscular fibres; the one orbicular, immediately surrounding the pupillary margin and acting as a sphincter; the other, extending in a radiated direction from the exterior circumference of the former to their insertions into the ciliary ligament, their action being to enlarge the pupil. One-fourth of the disc of the iris is occupied by the orbicular, and the remaining three-fourths by the radiated, muscle. The author has examined the structure of the iris in a great number of animals, and states the results obtained by M. Lebert, whom he applied to on numerous occasions, from numerous dissections of the eyes of animals belonging to each class of vertebrata. He also refers to a work which he published in the year 1812, entitled, "Mémoire sur l'Organisation de l'Iris," for evidence of the muscularity of the iris, which he obtained by applying galvanism to the human eye immediately after decapitation; and he concludes with the narrative of the case of a woman in whose iris there had been formed, by an accidental wound with the point of a knife, a triangular aperture below the pupil. This aperture became dilated when the pupil was contracted, and *vice versâ*; thus furnishing a proof that its movements were effected by muscular action.

BLOW-HOLE OF THE PORPOISE.

A PAPER, by Mr. F. Sibson, has been communicated to the Royal Society, by Prof. Bell, on this subject. The external opening of the air-passage of the Porpoise is so situated at the upper part of the head as to admit of the animal's breathing while only a small portion of its head is above the water. In its descent through the skull, between the cranial and facial bones, the tube is divided by a thin plate of bone into two nasal canals, which form, below this partition, a singular muscular tube opening at its lower part into the pharynx by a constricted aperture, through which the larynx projects upwards quite through the pharynx, dividing it into two channels. A series of pouches, five in number, capable of great dilatation, and provided with a muscular apparatus for retaining or expelling their contents, communicate by large orifices with the nasal canals, and appear to correspond in situation with the antra, frontal sinuses, and ethmoid cells. The author gives a minute anatomical description of these muscles, and an account of their modes of action; the adjustments of

the apparatus being such that the outer passage may be closed or opened above or below the anterior pouches. "When the outer passage is closed, the posterior pouches can be distended, and the anterior emptied; while the converse may be effected when the passage is open. The use of the pouches appears to be to buoy up the head, so that on the porpoise rising from deep water, the opening for breathing comes first to the surface, and admits of the animal's sleeping in that position, whilst its whole body remains immersed in the water.

THE LION, AS AN ARTICLE OF FOOD.

CAPT. C. KENNEDY, in his *Journey through Algeria and Tunis*, states:—"We were anxious to know if there was any chance of another lion being found in the neighbourhood, and were informed that, doubtless, there were plenty; but such was the nature of the ground, that, unless their exact haunts were known (in which case they were generally killed), we might go out for a fortnight, and never encounter a single beast. The skins of all lions killed throughout the regency are sent to the Bey, who pays a handsome premium upon each. The flesh is eaten; and, contrary to our expectation, we found it excellent, and made a capital supper upon the ends of the ribs stewed with a little salt and red pepper; it tasted like very young beef, and was neither tough nor strong flavoured."

ON A GIGANTIC STAG, (CERVUS EURYCEROS, ALDR.; MEGACEROS, HART.; GIGANTEUS, GALDE.) BY DR. E. EICHWALD.

CUVIER, after having described the fossil bones of the Gigantic Stag found in England, Lombardy, and throughout the whole of western Europe, expresses his surprise that none have hitherto been found in Russia and Siberia, where stags are at present so widely distributed. M. Eichwald records, in a memoir on the discovery of the bones of the same stag in the eastern part of European Russia, in the government of Simbirsk, where M. Sagykoff found fragments of the cranium and the horns of two individuals. They have likewise been found in Siberia on the north-west slope of the Altai, in the caverns of the arrondissement of Kolywanowoskressenkisch to the east of Schlangenberg, and in the vicinity of the river Tscharysch. In these deposits, the bones of the stag are very abundant; as well as those of the lama horse, rhinoceros, hyæna, dog, bear, gnawers, and bats.

The author adverts to the controverted question respecting the antiquity of this remarkable species. The beautiful cranium of the gigantic stag described by Goldfuss, has been found near Emerich along with urns and stone hatchets,—tokens of the existence of man. Another cranium was found in the peat-bogs of Lancashire, in formation similar to those where a boat was found. These historical facts have led some authors to believe that this gigantic stag was the same as the stag of Ireland, which disappeared in the twelfth century, and of

which ancient authors speak, being the same as the *Seg* of the ancient Britons, and the *Eurycerus* of Appianus. A magnificent antler of the gigantic stag of Bohemia, which the author has seen in the Imperial Museum of Vienna, and on which are engraved a few words in old Slavonian letters, indicate the origin of this animal; and the exploits of the chase related in ancient heroic poetry, justify the belief that the gigantic stag was then known. This animal was probably the *schelch*, which the poems in question inform us was hunted along with elks, aurochs, &c. It is, therefore, very probable, that being an object of chase, the gigantic stag disappeared from Europe two or three centuries ago, as the elk has disappeared from Italy, France, and Germany; and as the Bos primigenius and aurochs have so diminished that they are no longer found, save in the great forest of Bialowesha (in the government of Grodno), where, to prevent their total destruction, immense provision of hay is made for them every winter.

All these animals which were hunted in Germany probably lived, in former times, along with the mammoth and rhinoceros, since we find their bones intermingled in the same diluvian deposits. These latter appear to have perished first; and the others, especially the Bos primigenius and the gigantic stag, to have long survived them. Ferocious animals, such as hyænas, lions, and bears, may have been destroyed before them, in consequence of the interest man had in preserving himself from their devastations, before they thought of driving away less hurtful animals. The last lion lived in Greece in the time of Aristotle, near the rivers Archeolüs and Nestus. Pliny likewise mentions this animal as inhabiting Thrace and Macedonia.

Analogous occurrences appear to have taken place in America, for it is probable that the mastodon lived in historical times; and, just as the gigantic stag survived the mammoth, it appears that the mastodon survived the latter. This is demonstrated by the discovery of a complete skeleton of the *Mastodon* or *Missorium giganteum* in the valley of the Mississipi. The point of an arrow made of flint was still under the right hip of the animal,—a circumstance which completes the evidence that these gigantic animals lived at the same time as man.

It is useless to insist here on the confirmation which these facts furnish to the opinion we have elsewhere advanced (*Traité Elem. de Paleontologie*, tom. i. note A.) on the connection which exists between the diluvian and the modern epoch. These two epochs ought not perhaps to be distinguished; and they are certainly not separated by a destruction of species at the end of the first, and by a new appearance at the commencement of the second. It is very probable that *all the* existing species date from the origin of the diluvian epoch: *but that* a part of them have been destroyed, and have not reached *our times.* The changes of climate, and the influence of man, have been the causes of these disappearances of species, some of which are

taken place at periods too remote to have left any traces in tradition; but others of which are well known, and some are even taking place under our eyes.—*Professor Pictet; quoted in Jameson's Journal*, No. 82.

CLASSIFICATION OF BIRDS.

MR. J. HOGG, F.L.S., &c. has communicated to *Jameson's Journal*, No. 81, a paper detailing his Classification of the Birds of Europe, which he concludes as follows:—"As I have previously mentioned, that I would begin my general classification of birds by the *condor* (Sarcoramphus gryphus), and I would terminate it by the smallest species of *penguin*; so, in like manner, it will be seen, that I have commenced my distribution of the *birds of Europe* by the genus *Neophron*, a bird endued with great vigour of flight, and have concluded it by the *flightless Auk*. It will also be observed how I have placed the subtribe *Brevipennes* intermediately between the *Longipennes* on the one side, and the *Imperfectipennes* on the other; and thus gradually leading from the web-footed birds, possessing considerable power and swiftness of wing, to those which have almost no wings, or, at least, are entirely deprived of the faculty of flying. For, in reality, the wings of the latter are most imperfectly developed; being merely rudimental, with scale-like feathers, and useless as instruments of flight, they are alone serviceable as fins for the functions of swimming and diving. Thus, we find the birds comprised in my last family, *Spheniscidæ*, or the Penguins, in their form, habits, and marine mode of life, approximating most closely to the turtles, or amphibia, and to the following class of fishes.

"Lastly, in the preceding classification, the great increase in the number of families may, at first sight, appear objectionable to some ornithologists. But, on a further examination of it, I trust their objections will be removed; because I feel satisfied, that, by a more minute and extended division of the birds into such groups, we arrive at a more perfect and natural arrangement: and, at the same time, I consider it to be the only accurate method of attaining to a full knowledge of the differences presented in their organisation. And I am exceedingly gratified to find, that the view of that most distinguished philosopher and observer of nature, Alexander von Humboldt, precisely agrees with my own; for, in his work "*Cosmos*," now publishing (vol. i. p. 388), he thus writes: 'In the natural history of birds and fishes, the system of grouping into many small families is more certain than that into a few divisions, embracing larger masses.'"

ON THE RESPIRATORY APPARATUS OF BIRDS.

BY M. NATALLIS GUILLOT AND M. SAPPEY.

IT is a fact generally admitted, that in birds the air which reaches the lungs is *introduced* by permanent openings, in the cavity of the *abdomen, in the bones*, and in divers parts of the body. M. Guillot

has endeavoured to determine the position of the aërial reservoirs, and to show that it is an error to believe that the air can be introduced into all parts of the body of the animal.

He distinguishes the thoracic aërial reservoir and the abdominal reservoir. The latter is composed of two large spheroidal bladders, formed by a membrane of extreme tenuity, and separated by the mesentery and the mass of the intestines. Their origin is towards the base of the breast, on a level with the last rib, where we perceive an elongation of the lung pierced with many openings. The interior of these receptacles does not communicate with the peritoneum; they are bladders full of air, and nothing more: they are not cellular, like the thoracic reservoir.

When we place a living bird under water, and keep it there in such a manner that the respiration is free, we may open the peritoneum without a single bubble of air making its escape. Neither does any appear by cutting the cellular tissue, by raising the skin, and cutting the muscular masses. The same thing does not always take place after the death of the bird; for then, according to M. Guillot, gaseous bubbles arise from the blood. This anatomist thence concludes, that the air maintained by the envelopes of the two reservoirs above mentioned, cannot enter but into the bones, and that it neither enters into the peritoneum nor the cellular tissue; in a word, that it cannot diffuse itself through all the parts of the body during the life of the animal.

In connection with this communication, M. Serres refers to the analogous investigations of M. Sappey, demonstrator in the anatomical school of the hospitals; and this latter anatomist himself read a memoir to the Paris Academy of Sciences (9th and 23d July, 1846) on the same subject. The conclusions of his memoir are the following: 1st, There is no pleura in birds; 2d, The membrane which has been described under that name, is formed by the inferior bronchia of the lungs; 3d, All the bronchial ramifications are peripheral, and produce, by leaning against each other, a true aëriferous envelope; 4th, Not only does a diaphragm exist in birds, but it is an essential agent in the pulmonary dilatation; 5th, Observation rejects the existence of full cells, the communication of the respiratory apparatus with the muscles, the cellular tissue, and the feathers; 6th, The aërial reservoirs, annexed to the lung, are five in number on each side; 7th, These reservoirs, being of no use for respiration, are intended to secure the equilibrium of the bird during flight, and to diminish its specific gravity; 8th, The air which they contain becomes rarefied during inspiration, and condensed during expiration; 9th, The presence of air in the bones has the effect of augmenting their diameter and resistance, without increasing their weight; 10th, Finally, this same fluid penetrates directly into the feathers by an elliptical orifice, situate on their *under side*, and serves the same purpose in these organs as in the bony *levers*.

These researches, it will be perceived, will probably have the

effect of modifying greatly the notions generally adopted respecting the air contained in the different parts of birds.—*Jameson's Journal*, No. 82.

COMPARATIVE ANATOMY OF THE VOCAL ORGANS OF BIRDS.

Professor Muller concludes, from the facts he has observed, that the passerine songsters cannot form a natural division; and, contrary to the opinion of M. Nitzsch, he affirms that the *Picariæ* cannot be separated from them. The most natural groupes of the order of passerine birds contain types which differ in the organisation of the larynx, and the variable nature of this apparatus renders it but little fitted for the purposes of classification. It is the less so, since song may be produced by arrangements of structure very different from each other. The passerine order ought probably to be preserved in its most extended limits, comprehending even the syndactyli and the climbers; and it ought to contain, at once, birds possessing the most perfect vocal apparatus, and others which seem reduced to the greatest degree of simplicity.

The two most common forms of the vocal organ among birds, are—1st, The vocal muscular apparatus, formed on the type of that of our singing birds of Europe; 2d, The form of a single muscle, thick or slender. It is worthy of remark, that the first form prevails in Europe and Africa, and that the second is most common in America. Consequently, the forests of the Old World possess a greater number of birds truly songsters; those of the New World abound principally in birds with a loud and clear voice, but of little variety, and resound with cries rather than songs. Besides these two widely extended forms, there are many other laryngeal organisations of a more especial nature; the most complicated is that of the parrot tribe.—*Jameson's Journal*, No. 82.

BLACK SWAN, (CYGNUS ATRATUS, BENNET).

A beautiful specimen of this bird has been shot by Mr. Philp, Kincaple, on the river Eden. We believe this to be the first Black Swan shot in a wild state in Great Britain, if not in Europe. The bird in question is a female, and weighed 9 lbs. 3 oz.; measured 3 feet 9 inches in length, and 6 feet in extent of wing. The black swan was for many ages considered fabulous, but is by no means "*Rara avis in terris*." It is a native of Australia, where it abounds in the rivers and lakes, and on various islands along the coast, and is usually seen in flocks, which are very shy and watchful. Of late years, this bird has been introduced into our island, where it thrives and breeds. The whole plumage is black, with the exception of the primary quills and a few of the secondaries, which are white, but are obscured by the tertials, which are curled, and hang plume-like over them; the bill is bright red, crossed by a whitish band near the nail: the lare are *naked and red, irides* are also red, nostrils pervious, tongue slightly *ciliated; trachea simple*, and enters the breast in a straight line. The above specimen has been cleverly stuffed by Mr. Stirling, St. Andrews.

AUSTRALIAN PORCUPINE.

It is stated in the *South Australian Register*, that Mr. Hall has brought from Melbourne, a live Echidna, or native Porcupine, which was lately caught near Cape Shank. It is a singular species of the burrowing Mammalia, and the characters are—the muzzle or bill very slender, terminated by a small mouth, with the tongue extensive, like those of the ant-eaters and pangolins; and the probability is, that, like those creatures, it feeds chiefly upon ants, and other creeping insects. It is without teeth in its jaws, which, instead, are terminated by horny mandibles; but in the palate it has numerous rows of little spines. The feet are very short, and each furnished with five claws, very long, strong, and well adapted for digging. The whole upper part of the body is covered with spines, bearing some resemblance to those of the hedgehog; and when it is apprehensive of danger, and unable to escape from it by burrowing, it can erect its spines, and roll itself in a ball, like the hedgehog. These spines are not the entire covering, but are mixed with hairs; and on the lower part of the body there are hairs of a spinous form, which are tubular, and tapering to the points. Their shoulders are so formed as that the feet can work something after the fashion of the wings of birds; and the articulations of the shoulders are kept apart anteriorly by a sort of furcal bone. In this respect, the shoulders have a resemblance both to the lizard tribe, and to the smaller mammalia which burrow in the ground.

LONGEVITY OF A BEETLE.

Sir J. Richardson has exhibited to the British Association, a specimen of a Beetle (*Blaps mortisaga*), which had been found imbedded in some artificial concrete, where it must have been, at least, sixteen years; and yet, when the animal was brought to him, it was alive, and lived for six weeks after. Mr. Spence said that the ordinary duration of life of the *Blaps mortisaga* was two or three years; and that it should exist so long was very remarkable;—and he thought the circumstance deserved to be fully inquired into. Mr. Darwin stated that the *Blaps mortisaga* was very tenacious of life. He once left one, in a covered vessel, without food for a year, without its being killed. He had also dropped upon one hydrocyanic acid, but it walked off quite unaffected by the poison. Mr. Patterson stated that the larvæ did not possess such tenacity of life, as some he had kept had speedily died.—*Athenæum*, No. 986.

DRIVER ANTS OF TROPICAL AFRICA.

Dr. Savage has bestowed the name of Driver upon this species of Ant, from the circumstance of their appearing in vast swarms, and proceeding in their course in companies of great extent, with astonishing regularity, attracting every article of animal matter both living and dead, and driving before them all the smaller kinds of animals—whereby they rid a dwelling in an inconceivably small space of time of all its vermin occupants. Although of small size, they do not

hesitate to attack serpents several feet long; which, from their countless myriads, they soon destroy, having the instinct to eat out the eyes first. Dr. Savage possesses a number of specimens of the insect, consisting of neuter individuals of three distinct sizes—the largest of which act as soldiers. Each kind of individual exhibits a distinct structure of the mandibles, as well as a difference in the size of the head.

CULTIVATION OF SILK IN ENGLAND.

A LETTER has been received on this subject by the British Association, from Mrs. Whitby, of Newlands, near Lymington, Hants, wherein she gave the result of her experiments, begun ten years ago, on her own estate; and exhibited specimens of raw and manufactured silk, with full details. Mrs. Whitby commenced by planting various sorts of mulberry trees; and finds the Dwarf Philippine by far the best,—as producing more leaf,—and, from the facility with which its cuttings are struck, being more easily propagated than any other. She finds that, by procuring the eggs of the large Italian sort of four changes, she obtains as great a proportion, and as good a quality of silk, as they do in Italy or France. The testimony of several eminent manufacturers in London, Manchester, and Coventry, attest this. Mrs. Whitby has presented to the Queen twenty yards of rich and brilliant damask, manufactured from silk raised at Newlands. After making allowance for occasional unfavourable seasons, and labour, machinery, outlay of money, &c., it will be found that land laid out for furnishing food for this valuable caterpillar will afford a large profit.

Mr. Ogilby thought this a subject of national importance. The producing silk in this country had hitherto been only pursued as an amusement. Mrs. Whitby had demonstrated the possibility of obtaining a sufficient quantity of food at the right time,—which had hitherto been the great difficulty of growing silk in this country. He hoped the production of silk would be adopted in Ireland. The value of the silk brought to this country was above 2,000,000*l.* annually. Mrs. Whitby's silk was worth as much in the market as the best foreign silks. Mr. Monckton Milnes inquired if the *Morus multicaulis* would grow in all parts of this country, and whether anything would grow under it? Prof. Balfour thought that this species might grow over all England. He thought some other plant might be discovered on which the silk-worm would live as well as the mulberry. This plant belonged to an order which contained a milky juice; and all the plants, such as the lettuce and milk-thistle, on which the worm had been fed, contained a milky juice. Dr. Lankester thought it was not the milky juice alone that the silk-worm required,—as it was well known that the species of silk-worm accustomed to one kind of food would not partake of another. Thus, the silk-worm of India would not feed on the mulberry, nor the silk-worm of Italy on the jujube, and other plants on which the Indian silk-worm fed. Mr. Patterson referred to some papers read by Mr. Felkin, of Nottingham, before the Association, on the subject of the growth of silk in India; in which Mr. Felkin had stated that, in his

own experiments, worms that had been fed on lettuce, died rapidly, even after their food was changed for mulberry leaves.—*Athenæum*, No. 988.

At the last Annual Meeting of the Royal Cornwall Polytechnic Society, scarves were shown, which had been manufactured in Spitalfields from the produce of between 700 and 800 worms kept in an attic room in Truro. In size and weight, the worms rather surpassed those in Italy; the cocoons were larger; the quality of the silk, when reeled, was fully equal to the best imported, and the quantity exceeded the Italian average; and this in a season not remarkably propitious.

PHYSIOLOGICAL REMARKS ON THE STATICS OF FISHES, BY JOH. MULLER.

Like all other animals, Fishes have a very delicate sense of the equilibrial position of their bodies. They endeavour to counteract all change in this position, by means of movements partly voluntary and partly instinctive. These latter appear in a very remarkable manner in the eyes; and they are so constant and evident in fishes while alive, that their absence is sufficient to indicate the death of the animal.

The equilibrium of the body of a fish in the water is independent of the swimming bladder; that organ may even be injurious to it. The equilibrium of the fish, its horizontal position, with the back upwards, depends solely on the action of the fins, and principally that of the vertical fins.

The swimming bladder may enable a fish to increase or diminish its specific gravity. By compressing the air contained in it, the fish descends in the water; it rises by relaxing the muscles which produced this compression. Besides, the fish may continue in the deep parts of the water in consequence of the mere pressure of the column of water on the air contained in the bladder.

By compressing more or less the posterior or anterior portion of the bladder, the animal, at pleasure, can make the anterior or posterior half of its body lighter; it can also assume an oblique position, which permits an ascending or descending movement in the water. The arrangement of the swimming bladder in some fishes may favour this action. The Cyprinoides and Characins have two bladders, one before the other, and communicating with each other by a narrow neck. The anterior bladder is very elastic, while the posterior is very slightly so; accordingly, in proportion as the fish ascends in the water, the anterior and more elastic bladder must increase in size considerably, and tend to keep the head upwards, while the contrary must take place when the fish descends.

PROFESSOR AGASSIZ ON THE BRAIN OF FISHES.

At the meeting of the Helvetic Society, Professor Agassiz gave an account of his investigations on the encephalon of Fishes. The most striking fact on which he insisted, is that of the persistence of the forms of the Brain in the different families; forms on which, contrary

to the general belief, the instinct or the habits of the different species exercise no influence whatever. The consequence of this observation is, that the brain is not the expression of the propensities of the species, but of a particular mode of the organization of the animals. —*Bibliothèque Universelle*; *Jameson's Journal*, No. 79.

WHALE AND SHARK FISHING IN FAROE.

In the summer of 1845, there were killed about 2500 Caaing whales (*Delphinus melas*). A new kind of fishery has been tried: by Mr. Skibsted's experiment on taking sharks, he got above 250, from the livers of which he obtained about 102 barrels, or 3060 gallons of clear oil, and 40 barrels of thick oil, some of which, together with bones and blubber of the whales, and some guano, have been exported to Lynn, in Norfolk.

Sharks appear to have lately become much more numerous in Faroe, as they have also in other parts of the North Seas, especially on the coast of Norway. — *Communicated to Jameson's Journal*, No. 79, *by W. C. Trevelyan, Esq.*

DREDGING CRUISES.

The Notes on New and Rare Animals observed during Cruises in the British Seas, by Professor E. F. Forbes and Mr. M'Andrew, since the last meeting of the British Association, enumerate many new and rare specimens; and when the classes shall have been carefully examined, the number of animal forms added to the British Fauna during these researches will probably not fall far short of a hundred. One of the most remarkable animals taken is a new genus of crabs, belonging to the fossorial type of that class, and to the family Thalassinideæ. It was taken in 180 fathoms water, and its structure is in accordance with the habits of an animal living at so great a depth in the ocean; for it possesses very feeble organs of vision, and it is questioned if it has the power of seeing at all.

PULMOGRADE MEDUSÆ OF THE BRITISH SEAS.

Prof. E. Forbes has communicated to the British Association, the results of his researches since 1839; and having now, however, examined more than twice the recorded number of British Medusæ, and become acquainted with numerous new specific, and several new generic, forms of great interest to the naturalist, he has submitted to the Zoological Section an outline of the data in his possession. In grouping the British species, Prof. Forbes calls attention to the mutual correspondence of certain characters; viz. of the condition of the reproductive, digestive, and sensitive systems. He proposes to group all the British Medusæ under such as have hooded and such as have naked ocelli. The first character is combined with a conspicuous and comparatively complicated reproductive system, and a ramified *gastro-vascular apparatus*. All the pulmograda with naked ocelli have *simple vessels*, with one exception—a new and most beautiful generic *form, the type of* a sub-section by itself. The remainder form three

natural groups, as will be seen in a general table, exhibiting the arrangement of the Medusæ, in the *Athenæum*, No. 986.

PROTOCOCCUS "ATLANTICUS."

THIS new species of sea-weed, discovered and named by M. Montaigne, is one of the smallest of the genus Protococcus, measuring only from 1-300th to 1-200th of a millimetre in diameter; so that to cover the space of a square millimetre, 40,000 individuals, placed side by side, would scarcely suffice. And yet, to this alga, the red colouring of the sea for about eight square kilometres, observed off the coast of Portugal by MM. Turrel and De Freycinet, is attributed.—*Literary Gazette*, No. 1558.

BORING POWER OF LAND-SNAILS ON LIMESTONE.

FEW persons are (says Mr. W. C. Trevelyan), aware of the fact, which I alluded to at the meeting of the British Association in Cambridge last year, on the occasion of a notice by Dr. Buckland, "On the agency of land-snails in forming holes and trackways in compact limestone," that this phenomenon had been noticed many years ago by the late amiable and talented author of the *History of Northumberland*, the Rev. John Hodgson, an accurate observer of nature, who, in 1827, published in that work (Part 2, Vol. i., p. 193) the following passage:—"On a sunny bank, near Whelpington, a stratum of limestone" (carboniferous) "is here and there seen in grey projecting masses, the *under* surface of which if bored upwards into cylindrical holes, which are from a line to four inches deep, and tenanted, especially in winter, by the banded and yellow varieties of the *Helix nemoralis*. The *limaz*, while it occupies these cavities during the summer, has its fleshy longitudinal disk protruded out of the shell, and coiled nearly into a circle on the surface of the stone, the summit of its shell hanging downwards; and in this position it probably elaborates its den in the same manner that some of the *pholades* work their way into clay and wood; or, by a slow but constant process, sink and enlarge their cells in the hardest stones." I had, some time previously to the date of this publication, examined the spot, and was satisfied with the correctness of Mr. Hodgson's observations; and in October, 1845, took advantage of an opportunity to revisit it, and was confirmed in the opinion I had before formed on the subject, and in the perfect accuracy of the description quoted above.

The thoroughly sheltered position of the *under* surface of the rock precludes the possibility of the holes being an effect of weathering; and I feel convinced that they are the result of the slow, but nearly constant action, of a weak acid secreted by the snails, which instinctively, for the sake of shelter, would resort to such a situation; *and thus*, in the course of ages, such holes would be formed in any *substances* on which the acid could act.—Communicated to *Jameson's Journal, No.* 80.

ON THE RECENT SCOTTISH MADREPORES, AND THE CLIMATIC CHARACTER OF THE EXTINCT RACES.

The Rev. Dr. Fleming has communicated to the Royal Society of Edinburgh, a paper referring, in the first instance, to the three species of Lamelliferous Polyparia, described in his "British Animals," Edin. 1828; exhibiting specimens of the *Caryophyllea cyathus* and *Turbinolia borealis* of that work, together with a characteristic drawing, by the late Mrs. Hibbert, of the *Pocillopora interstincta*, there alluded to as a native of the Zetland seas. He then exhibited a specimen, six pounds in weight, of the *Madrepora prolifera* of Müller, which was found last summer by fishermen, their lines having become entangled with it, in the sea between the islands of Rum and Egg. This species was known to Pontoppidan as a native of the Norwegian seas, and is now ascertained to be a native of the Hebrides.

The author next exhibited specimens of the *Turbinolia sepulta* of the crag, together with a new and recent species from the Cape of Good Hope. In conclusion, the author observed, that while, from an acquaintance with the habits of a few *individuals*, we could safely speculate respecting the geographical and physical distribution of a species, we cannot, from our acquaintance with one species of a genus, predicate with any confidence respecting the character of other species of the same genus. Thus, there are species of madrepores natives of tropical seas, and there are species natives of the North Seas. After illustrating his views by a reference to the species of the genera *Bos Elephas*, the author closed his observations by stating, that the evidence proving the climate, during the deposition of the mountain limestone, to have been warmer than at present, as derived from its contained organic remains, was defective; since the organisms compared did not belong to *individuals* of the same species, but to species of similar genera.—*Jameson's Journal*, No. 81.

RED COLOUR OF THE BLOOD IN THE PLANORBIS IMBRICATUS.

By observing the *Planorbis imbricatus* by means of a transparency, M. de Quatrefages has ascertained that this little mollusc, which is very common in the fresh water around Paris, possesses blood of a red wine colour. Under a faint magnifier, the liquid may be seen filling the cavities of the pericardium and ventricles; and, by its motions, colouring pretty distinctly the whole general cavity of the body on its lower surface. M. de Quatrefages could not perceive distinct globules in this liquid. Other planorbes of very small dimensions possess white blood. M. de Quatrefages presumes that these are the young of *P. imbricatus*, the blood not acquiring its characteristic tint but by age; and he remarks, that if this conjecture be verified by the observations which he proposes to continue, the processes will go on in these molluscs exactly as among the annelides.—*Jameson's Journal*, No. 82.

SHELLS OF MOLLUSCS.

Mr. L. Reeve has communicated to the British Association, a

paper "On the Dissimilarity in the Calcifying Functions of Molluscs, whose Organization is in other respects similar." The four shell-secreting kinds of cephalopods—the cuttle-fish, the paper nautilus, the pearly nautilus, and the spirule or ram's horn—each exhibit a different method of forming its shell, differing in microscopic structure, and secreted from different parts of the system; although strictly allied in all those elements of anatomical detail which constitute the soft parts, or animal frame. Whilst the calcareous portion of the cuttle-fish are merely represented by an internal bony plate, consisting mainly of carbonate of lime, the shell of the pearly nautilus constitutes a huge mechanical apparatus, secreted from the mantle enveloping the visceral mass, and consisting of two separate deposits, an outer crust, and an inner nacre, for the purpose of buoying up its inhabitant under the different mutations of pressure, to which it is subjected in its deep region of habitation. The shell of the paper nautilus, on the other hand, is a light elastic boat, transparent and permeable to light, secreted only by the female for the purpose of containing her eggs; and in this animal, the office of calcification is transferred, by some mysterious order, from the mantle to the hinder pair of arms. The spirule is again totally different, it being contained within the mantle of an animal far larger in proportion than that of the other cephalopods, under circumstances which at present remain unknown. The drawing exhibited was taken from a living specimen, recently collected at New Zealand, for the first time in perfect condition; but, as the proprietor is unwilling that it should be dissected, Mr. Reeve could only state that it contained a problem in the physiological history of cephalopods which it was extremely desirable to solve. The next point to which he directed the attention of the Section was the curious difference which takes place in the growth of the cowrey and the olive, and which he had more fully communicated to the Linnean Society.—*Athenæum*, No. 989.

DEVELOPMENT OF THE ANNELIDES.

The development of the Annelides was only known, till of late years, by works on the leech; and it was erroneously concluded, from analogy, that all these animals, on issuing from the egg, had the general form of body exhibited by the adult. M. Sars has confirmed the discoveries of M. Loven respecting the metamorphoses which certain annelides undergo, by carefully describing the development of the *Pölinoe cirrata*, which is common on the coasts of Norway.

They thus approach the other annelides, and also the myriapodes, embryos of which quit the egg, according to Waga and Newport, in a very imperfect state, and completely destitute of articulated appendages.

STRUCTURE OF CRISTÆLLATA MUCEDO.

Prof. Allman has detailed to the British Association, several interesting peculiarities of structure in this beautiful little Bryozoa, added to the Irish Fauna by him. Of these peculiarities the author

considered one of the most important to be the detection of a small roundish body, situated at the upper end of the pharynx, and which he believed to be a nervous ganglion. The author also dwelt upon the existence of a delicate calyciform membrane which unites the bases of the tentaculæ, and is of very general occurrence among the fresh-water Bryozoa. This structure he considered peculiarly interesting, as it tended, with other facts, to homologize the tentacular system of the Bryozoa, with the branchial rack of the Ascidiæ. Several peculiarities in the digestive and muscular systems were also alluded to; the muscular fibre being shown to be obscurely striated, and to exhibit a tendency to break into disks. The ova, in their young state, are inclosed in a ciliated membrane; and the hooked spines with which, in their more mature condition, they are furnished, are developed within the ciliated investment, being of subsequent growth, but yet fully formed previously to the ova quitting the parent. The facts detailed in the present communication were assumed by the author as affording much additional evidence in favour of the molluscan nature of the Bryozoa.

Prof. Owen regarded this as an important paper. It was, however, difficult to say what we must consider as a molluscus; and, therefore, it is difficult to assign the affinities of the mollusca. The supposed affinity of this animal to the Rotifera was evidently wrong; there was, however, an analogy which had misled. The observations made on the muscular tissues of this animal by Prof. Allman were interesting. Dr. Carpenter always thought that the Bryozoa occupied a position intermediate between Polyps and Mollusca. He could not, however, agree with Professsor Allman, that the little mass at the mouth of the animal was nervous. Professor E. Forbes stated his conviction that these animals were more nearly related to the Mollusca than to the Polyps.

BOTANY.

DIRECTION OF ROOTS.

M. Durand has made to the Paris Academy of Sciences, another communication relative to his experiments, with a view of confirming his discovery of the cause of the Roots of Plants striking downwards. These leave no doubt that the roots shun the action of light; and that this is the cause of their pressing their way into the earth.—*Athenæum*, No. 966.

FLORA OF CHUSAN.

In 1843, Mr. Fortune left England, commissioned by the Horticultural Society, to proceed to China in search of plants. He arrived there on the 6th of July, and returned to England in May 1846. From the results of his journey, we select the following on the Flora of Chusan, which, Mr. Fortune says, "is very different from those *portions of the south* which I have already described. Almost all the *species of a tropical* character have entirely disappeared, and in their *places we find others* related to things found in the temperate parts of

the world. I here met for the first time the beautiful *Glycine sinensis* wild on the hils, where it climbs in hedges and on trees, and allows its flowering branches to hang in graceful festoons by the sides of the narrow roads which lead across the mountains. The *Ficus nitida*, so common around all the temples and houses in the south, is here unknown; and many of those beautiful flowering genera which are only found on the top of the mountains in Hong Kong, here have chosen less exalted situations. I allude more particularly to the *Azaleas*, which abound on the hill sides of this island. Most persons have seen and admired the azaleas which are yearly brought to the Chiswick fêtes, and which, as individual specimens, surpass, in most instances, those which grow and bloom on their native hills; but few can form any idea of the gorgeous and striking beauty of these azalea-clad mountains, where, on every side, as far as our vision extends, the eye rests on masses of flowers of dazzling brightness and surpassing beauty. Nor is it azaleas alone which meet the eye and claim our attention; clematises, wild roses, honeysuckles, the Glycine sinensis, noticed above, and a hundred other things, mingle their flowers with them, and make us confess that, after all, China is indeed the 'central flowery land.' There are several species of myrtaceous and other ericaceous plants, which are also common on the hills; but no species of heath has been ever found, and I believe the genus does not exist in this part of China."

A brief sketch of Mr. Fortune's proceedings has been printed for the use of the fellows of the Horticultural Society. As he proposes publishing his personal narrative, the Society has permitted him to reserve the full details of his Observations on Chinese Agriculture and Horticulture for that work.—*Quoted in the Daily News.*

SPONTANEOUS COMBUSTION.

LAST summer, the banks of the Cam exhibited an unusual multitude of those singular phenomena—cases of Spontaneous Ignition and Combustion in growing Willows. It was really astonishing to look upon a fine willow, in the full vigour of robust vegetable health, pouring forth clouds of smoke from its half-burned stem, and doomed speedily to expire—itself its own funeral pile. How explain this? How account for the fact that this tree, yet hale and green, covered with a rich mass of foliage and flourishing "like a green bay tree on the river-bank"—should suddenly burst forth into ignition, burn like tinder to its very core, and to-morrow be prostrate?—*Cambridge Advertiser.*

SOAP AND BUTTER TREES.

MR. J. F. DUNCAN has forwarded to the British Association, a fruit in many respects resembling an orange which he had observed grow abundantly in Africa. When pulled from the tree in a ripe state, the interior substance is about the consistence of an orange, and is considered superior to anything manufactured in England, as Soap. Mr. Duncan also noticed the Shea Butter Tree, growing in Africa,

first discovered by Mungo Park. It produces from its seeds a quantity of oily matter, which is used by the natives as butter. It is as hard as tallow, and may be used for making it. Some candles made of the oily secretion were exhibited, and burnt; where they gave as good a light as those from any other oleaginous compound used for this purpose.

CLOVE-TREE.

THERE has been exhibited to the Horticultural Society, a cut specimen of the Clove-Tree, (*Caryophyllus aromaticus*), from the Duke of Northumberland. This remarkable tree, on account of the difficulty of keeping it alive, is still comparatively rare in this country. At Sion House, however, it is found to succeed well, planted in Norwood loam and sand; in which it was mentioned the Mangosteen and Nutmeg likewise thrive. The specimen exhibited bore large, shining, pale-green leaves, and had on it several of its fragrant coriaceous flower-buds,—which are the cloves of merchandise; the corolla forming a ball or sphere on the top between the teeth of the calyx; thus, with the narrow base or germen tapering downwards, giving the appearance of a *nail*; and hence in French the name *Clou*, from which the English, Clove, is evidently derived. A Knightian Medal was awarded for the specimen.

LEAVES OF THE COFFEE-TREE AS A SUBSTITUTE FOR TEA.

PROF. BLUME, of Leyden, has laid before the Meeting of Naturalists of Bremen, samples of Tea prepared from Coffee Leaves, which in appearance, odour, and taste of the decoction, agree entirely with that from genuine Chinese Tea. It has long been employed as such by the lower classes in Java and Sumatra.—*From the German of Buchner.*

THE TEA-PLANT IN FRANCE.

THE *Journal des Débats* states, that the experiments made for introducing the culture of the Tea-Plant in France have fully succeeded. The tea plant has been found to thrive as well in Angers as at Hyeres, under the warmest climate of Provence: this is considered a fact without example in the history of this plant since its introduction in Europe, and demonstrates that the climate of France is favourable to the culture of the tea-plant. The experiments made in Algeria have not been so successful; all the plants were killed by the heat, notwithstanding every precaution. Between the provinces in the north of France, the climate of which appears too cold and humid, and the burning plains of Algeria, there may be selected the provinces of the south, where, by choosing good soils and favourable sites, there could be no doubt but the tea-plant might be cultivated with success.

THE POTATO DISEASE.

IN the *Year-Book of Facts*, 1846, p. 236, we briefly glanced at the *ravages of the Potato Disease in 1845.* We now learn from a paper

by a distinguished Botanist, in the *Illustrated London News*, No. 226, that—

The damage has been estimated at £18,000,000 for the United Kingdom: Professor Lindley has computed it to have been £3,500,000 for Ireland alone.

Whatever the past fact may have been, it is certain that the injury sustained in the year 1846, is very much more considerable, perhaps twice as great; for many new districts are attacked, no old ones are spared, and the destruction is in all cases more extensive.

The real cause of this sudden visitation is unknown. Some have ascribed it to the ungenial season of 1845, and that has been the prevalent idea; others have fancied that the life of the potato is wearing out; many believe in electrical agency, and talk of blue lights seen at night playing over the doomed potato grounds; insects, worms, parasitical fungi, night frosts, vegetable cholera, all have in turn had their advocates.

None of the Scientific Commissions which have been issued by European Governments have ventured to pronounce any opinion on the subject.

But, although the cause is unknown, the symptoms have become too familiar. In all cases, the leaves become black and soft, in roundish patches; and, quickly after, the tubers change here and there to a brown substance which resembles a decayed apple, and eats into their centre; in some instances, especially in warm, damp places, this is followed by a putrid decomposition, accompanied by an indescribably offensive smell; in others, it is not more disagreeable than a rotten apple. It is very remarkable that this decay injures the starch in no considerable degree: so that, by mere grinding and washing, it may be extracted from the most decayed potatoes, cleaned, and used for food.

It is not, however, in the leaf that this curious disease really begins. Weeks before there is any sign above ground, the foundation of the mischief is laid, by the appearance of a brown blotch on the young stem, just above the old set. This invariably precedes every other symptom, as was first pointed out by Professor Lindley. The writer of this has examined hundreds of cases, without in any instance finding an exception to the rule. It seems as if the old tuber contained the germ of some affection, or some undiscoverable deleterious matter, which acted upon the young stem just after it began to push; that this was by degrees communicated through the subtle tubes of the stem, and, by degrees, corrupted the juices of the leaves.

Be this as it may, the blotches of the leaves are instantly assailed by countless myriads of a minute parasitical plant, called *Botrytis infestans*, similar to those which mildew corn and other crops, which seems to be a constant follower of the potato disease. A very full account of this plant has been given by the Rev. Mr. Berkeley, in the Horticultural Society's Journal. When the blotches are first examined nothing perhaps will be seen; but if their underside is steadily looked at for a minute, especially when held a little obliquely, by degrees the eye will observe a minute grey mouldiness on the edges of the blotch, especially beyond them. The mouldiness is the parasite; it has a spawn like a mushroom, which it insinuates among the cells of which the leaf consists, and it finally emerges by the breathing pores of the plant.

Some naturalists believe that this "parasite" causes the disease; all that we, however, can venture to say is, that it appears to be in some way or other connected with it. Acting upon that opinion, Professor Morren, of Liège, very early in 1845, recommended the stems and leaves to be pulled up and removed from the tainted fields; he thinking that if the parasite were removed, the tubers would not be injured by it. The practice has been to a small extent adopted in France and Great Britain; and, in the opinion of good judges, with decided advantage.

(*See* the entire paper, with several illustrations, in the popular *Journal*, above quoted.)

APHIS VASTATOR, THE SUPPOSED CAUSE OF THE POTATO DISEASE.

(See the Vignette.)

AMONG the investigations of this subject, not the least striking is the experience of Mr. Alfred Smee, contained in an elaborate work which he has published.*

According to Mr. Smee, the disease is no novelty to Europe, as, from the accounts which he has collected of the curl, as described by various authors, it appears that the present malady is probably identical with the disease which threatened the Potato crop about forty or fifty years ago, but which eventually passed away, and was nearly lost. Martius states that the present epidemic existed in Germany since the year 1830; and, in 1842, this author, by order of the Government of Bavaria, wrote one of the most elaborate treatises which has yet appeared upon the subject.

Mr. Berkeley, as shown in the abstract quoted at p. 240, thought that the disease was due to the Botrytis. Martius attributed it to the action of a Fusisporium, of which he has given numerous figures. Mr. Smee confirmed the view taken in the previous paper; and, although he has made mention of numerous fungi which he has observed upon the diseased plant, yet he states that they always come after the plant has been damaged, and "eat off, as it were, the soft decaying parts, as fast as they rot."

Previously, however, to the occurrence of these fungi, which afford beautiful microscopic objects, Mr. Smee states that he had discovered one particular Aphis which comes before any part of the plant exhibits the malady. This Aphis he has named the Vastator or Destroyer, to mark its injurious action upon numerous articles of human food. It has been previously known to entomologists as attacking the turnip, and named, therefrom, the Aphis Rapæ. It is an insect in some degree resembling the green fly of the geranium, or the Aphis which attacks the rose, though it presents specific differences from both these insects.

It comes upon the larger leaves of the potato plant in the winged state, where it speedily produces numerous young ones, which crawl over the plant. Although this creature prefers the larger leaves, it sparingly lives upon the young shoots of a sprouting potato. It has a curious apparatus by which it pierces the leaves, sucks the juices, and thus feeds upon that material which is destined to nourish the plant. The piercing apparatus consists of three fine setæ, which lie in the groove of the rostrum, and are thrust out of its apex when it feeds.

The Vastator brings forth its young alive. The young ones begin to feed directly they are born. In the first state they are called Larvæ, and in a few days bring forth other young ones. After a time, the rudiments of wings appear, when the creature is said to be a Pupa; and, lastly, it sheds its skin, and emerges with four large wings. In shedding its skin, it parts with the setæ, and the cast slough affords a very beautiful microscopic object. The winged insects, after a slight pause, take flight, and frequently appear in the form of a great cloud, which passes from one part of the country to another, and settling here and there produce the direful mischief which we have already described. According to Mr. Smee, they not only damage the plant for the time being; but they render the plant so debilitated that all future growths are liable to exhibit the disease.

Mr. Smee has found this insect in the turnip, beet, carrot, spinach, tomato, horseradish, celery, and various other esculent plants; and he has described the changes which take place subsequently in these plants as being similar to those observed in the potato. The turnip rots in the bulb; the carrot rots in its central part; and we observed in one of the poor districts of London numerous carrots which were apparently affected in the manner figured in Mr. Smee's work.

* "The Potato Plant; its Use and Properties; the Cause of the Present Disease: *the Extension of* that Disease to other Plants; the Question of *Famine arising therefrom*; and the Best Means of Averting that Calamity." *By Alfred Smee, F.R.S.* Illustrated with ten Lithographs. Longman and Co.

Aphides are greatly kept in bounds by other insects, such as lady-birds, gauze-wings, and minute hymenopterous insects, which deposit their eggs in the Aphis, which turns to a maggot, and gradually eats up the creature, and finally emerges through a small hole in the skin, as a winged insect.

Mr. Smee has called the attention of the naturalist to the growth of fungi following the attacks of all Aphides. He mentions, in illustration, the large fungous blotches on Sycamore leaves which follow the attacks of a large Aphis.

In consequence of the interest which now attaches itself to the family of Aphides, their effect upon plants in causing them to perish will be thoroughly investigated next summer.

Mr. Smee has also published the following directions for preventing future mischief:—

1. Cultivate all crops to the usual extent.
2. With regard to Potatoes, use sets from former healthy plants.
3. Select early varieties.
4. Plant early.
5. Use but little or no manure.
6. Choose a sandy or peaty soil.
7. Destroy the plants on which the Vastator is now living.

These rules are immediately applicable, but it is manifest that they do not contain recommendations for the treatment of the crops when actually infested by Aphides. Previous to their visitation we hope that some cheap, simple, and effectual means will be discovered for their eradication, and with their destruction the disease in the potato plant will cease.

We have selected the preceding from a valuable paper, (with nineteen engravings,) contributed to the *Illustrated London News*, No. 246. The Vignette, in our title-page, shows the winged *Aphis Vastator*, highly magnified.

ORGANIC CHEMISTRY.—THE POTATO DISEASE.

A PAPER has been read to the British Association, 'On the Application of the Principles of a natural system of Organic Chemistry to the Explanation of the Phenomena occurring in the Diseased Potato Tuber,' by Dr. Kemp.—The object of the author is to urge the consideration of his views on the following grounds:—1st. That, on the 24th of February last, he announced to the Cambridge Philosophical Society, as one of the mean deductions from his analyses, that the nature of the morbid affection in the potato tuber consists in an abnormal tendency to premature germination. 2nd. That the truth of this deduction has been proved to the very letter by the progress of the growth of the tuber consequently; and that attention was drawn to the subject by Prof. Lindley, in the *Gardeners' Chronicle*, on the 1st of August, simply on the grounds that this tendency to premature germination had become a matter of notoriety. 3rd. That, by the application of the natural system of organic chemistry, the outlines of which were brought before the last meeting of the Association, it was in his power to establish an important principle, which had baffled the genius and resources of the Commission appointed by Government to investigate the subject.

Some remarks followed, which bore on the importance of autumn planting. Numerous striking instances were adduced in which healthy potatoes had been grown from diseased tubers planted in the autumn.

Geology.

THE GLACIAL THEORY.

The following are among the more important contributions to the evidences of this theory during the past year:—

Prof. Forbes has communicated to the Royal Society, a paper "On the Viscous Theory of Glacier Motion." Part II.*—"An attempt to establish by observation the Plasticity of Glacier Ice."

The two first sections of the present memoir are occupied with a critical examination of the theory advanced by De Saussure to account for the progressive motion of Glaciers, which he considered as formed of masses of rigid and inflexible ice; and with the further explanations of that theory given by Ramaud, Bischoff, Agassiz, and Studer. The author, on the other hand, regarding these masses as possessing a considerable degree of plasticity, explains on that supposition the phenomena they present; and, in the third section of the paper, he relates a series of experiments which he carried on in the Mer de Glace, near Chamouni, in the summer of 1844, with a view to determine by direct measurement the relative motion of different parts of the glacier. This he accomplished by selecting a spot on the western side of the Mer de Glace, between Trelaporte and l'Angle, where the ice was compact and free from fissures, and erecting on the surface a row of posts at short distances from one another, in a line transverse to the general direction of the moving mass. He was thus enabled to discover, by trigonometrical observations, the movements of different points in this line; and he ascertained that they advanced more and more rapidly in proportion as they were distant from the sides of the glacier; and that, when not under the influence of neighbouring *crevasses*, these motions were gradual and uninterrupted, as was shewn by the lines carried through the posts forming, after the lapse of a few days, a continuous curve, of which the convexity was turned towards the lower end of the glacier.

Part III. of this paper has also been read, in which the author inquires into the motion of those comparatively small isolated glacial masses reposing in the cavities of high mountains or on *cols*, and called by De Saussure *glaciers of the second order*. A glacier of this description in the neighbourhood of the Hospice du Simplon, lodged in a niche on the northern face of the Schœnhorn, immediately behind the Hospice, and at an elevation of about 8000 feet above the sea, was selected for observation. The average velocity of its descent was found to be about one inch and a half in twenty-four hours; those parts in which the slope was 20° moving with a velocity about one-third *greater than* those in which the slope was 10°. The author

* *For Part I. see* Year-book of Facts, 1846, p. 243. Prof. Forbes's Nine *Letters will be found* in the above and the five preceding Year-books.

next enters into general views on the annual motion of glaciers and on the influence of seasons, adding tabular details of the observation. A glacier, he contends, is not a mass of fragments or parallel-opipedons; neither is it a rigidly solid body; and, although it may be extensively intersected by crevices, these "crevasses" are comparatively superficial, and do not disturb the general continuity of the mass in which they occur. The water contained in these crevices is only the principal vehicle of the force which acts upon it; and the irresistible energy with which the whole icy mass descends from hour to hour, wth a slow but continuous motion, bespeaks of itself the operation of a fluid pressure acting on a ductile or plastic material.

In No. 79 of *Jameson's Journal*, are two valuable papers relating to Erratic Blocks, Grooved Surfaces, and the Action of Glaciers: the one by Mr. Maclaren; the other by Professor James D. Forbes. The paper of Mr. Maclaren describes grooves and striæ which he observed in the summer of 1845 on the rocks on each side of the Gare Loch, in Dumbartonshire; and these, together with blocks and an accumulation of loose materials resembling a terminal moraine, appear to indicate very clearly the former existence of a glacier in the space inclosed between the hills that bound the loch. He also observed numerous rounded blocks in the same locality, which could not have been produced by the same glacier; for they consist of granite, some of great size, as much as five feet in diameter, at various heights on the hills: one on the top of a hillock 320 feet above the loch; and no granite,—no parent rock to which they can be traced,—is nearer than forty miles to the north; but between the localities where they now exist and that parent rock, there are ridges over which they must have travelled that are 1500 feet above the present sea-level. This, then, is a case analogous to that of the Valdai Hills in Russia, on the southern flanks of which blocks of Scandinavian granite are scattered, indicating that these hills,—and, in like manner, the summits of the barrier north of Gare Loch,—were a sea-bottom, upon which the blocks were dropped from floating icebergs,—that sea-bottom being subsequently raised to form the existing land.

The principal object of Professor Forbes's paper is to describe the topography and geological structure of the Cuchullin Hills in Skye. He gives us much new and interesting information respecting the igneous rocks of which they are composed, particularly that comparatively rare variety, hypersthene rock; but he also describes these same rocks as being furrowed and polished in several of the valleys, but especially in the valley of Coruisk,—the furrows there radiating from a centre to the sea-shore; and, in his opinion, they demonstrate, in as clear a manner as the subject admits of, the former existence of a glacier in that locality.—*The President (Horner's) Address at the Anniversary Meeting of the Geological Society of London*, 1846.

MR. MILNE has communicated to the Royal Society of Edinburgh, a Notice of Polished and Striated Rocks discovered in the gully situated between Arthur Seat and Sampson's Ribs, which are found to be

smoothed as well as furrowed or scratched. The gully is about 30 feet wide, at the lowest level to which it has been hollowed out, and at one part both of its sides are composed of these smoothed furrowed rocks; but, in general, it is only on one side, viz. that next to Arthur Seat, that rock exists. There, the appearances of smoothing and rutting extend for about 80 yards. The gully runs about N.W. and S.E. by compass. The highest point in it is near the north end. At both ends it is open, and sinks to a level with the adjoining level country. The gully is about 200 feet above the level of Duddingston Loch, and 400 feet above the sea. Arthur's Seat forms on the east side of it a precipitous cliff of about 250 feet.

The opinions formed by the author on his data were:—

1. That the agent which had polished and scratched the rocks on Arthur Seat, was the same as that which had polished and scratched the boulders.

2. That it had acted from the north-westward over a large and low district of country.

3. That the polishing and scratching had been effected by the gravel and angular blocks existing in the boulder clay and diluvial gravel.

4. That there had been rushes of water along the country, which bore along the mud, sand, gravel, and boulders, now spread over the country, and which, in passing over the rocks and large boulders, smoothed and rutted them.

5. That, at this period and subsequently, water must have stood, in a comparatively tranquil state, above the level of Sampson's Ribs, to account for the beds of sand existing on the south side of Arthur Seat, and at a level of 200 feet above Duddingston Loch.

6. That the outline or configuration of the district, thus submerged, could not have been materially different from what it now presents.

Mode of distinguishing Rolled Blocks of Rock resulting from Glaciers, from those produced by the action of Water.— M. Edward Collomb has sent to M. Elie de Beaumont, a series of interesting Striated Blocks of Rock from the Vosges. M. Agassiz attaches great importance to these specimens, and makes the following observations in a letter addressed to M. Collomb, an extract from which has been read to the Geological Society of France by M. Elie de Beaumont: "Wherever I have met with glacial deposits, I have found great numbers of rounded blocks of rock, which are polished and scratched in the same manner as polished rocks *in situ*, with this single difference, that the blocks which were moveable between the glacier and the fixed rock exhibit scratches crossing one another in all directions. Blocks of the same description are found beneath all existing glaciers, but never in the channels of torrents, nor on the *shores of the Swiss lakes*. In my opinion, this character is the most *certain guide for* enabling us to distinguish glacial formations from *deposits of blocks* transported by currents. A curious fact in support

of this distinction is, that the scratched blocks which are carried along by the torrents issuing from the glaciers lose their *burinage* at a short distance from their origin, and assume the dull and uniform aspect of rolled blocks resulting from aqueous transport."—*Jameson's Journal*, No. 79.

In the year 1844, (writes Mr. W. T. Trevelyan, to *Jameson's Journal*, No. 80,) I observed evident traces of glacial action (polishing and grooving) on some of the trap-rocks above high-water mark, on the south side of the ancient burial-ground near the harbour at North Berwick; in Sept. 1845, Mr. Trevelyan found also unequivocal traces of the same action on the rocks of the north face of North Berwick Law, where the unweathered surface had been recently exposed. Mr. Trevelyan observed similar traces on the horizontal surface of a very hard bed of the old red sandstone, which forms the summit of the "Red Head," in Forfarshire. The direction of the scratches or grooves in all these cases appears to indicate the motion of ice from the land toward the sea.

Mr. Trevelyan, also, in a letter to Dr. Buckland, directs his attention to certain polished scratched surfaces in the valley of the Conway, on the ascent of Moel Siabod, and in other places near Swowdon. The author considered that these and other markings he had observed, were indications of the former presence of glaciers in these localities.—*Quarterly Journal of the Geological Society*, No. 3.

NATURAL HISTORY AND GEOLOGY.

Prof. E. Forbes has communicated to the British Association, "Notices of Natural History Observations made since last Meeting bearing upon Geology." The principal facts communicated are—1. The discovery, in a living state, of several species of Mollusca hitherto known in this region only as fossils. *Leda pygmæa*, *Arca raridentata*, and *Astharte Withami*, were the instances, all taken by Mr. M'Andrew and Mr. Forbes in the British seas. They have also taken the *Turbinolia Milletiana*, till lately a characteristic miocene fossil, alive, off the Land's End, and have proved the animal to be scarcely different from *Carpophillia*. 2. The dredging from deep sea at a distance from land of several species known only as fossils in Europe, as *Leda obtusa* and *truncata*, and *Pectan Islandicus*. 3. The observation that several rare species now living in our seas appear at a comparatively recent period to have been much more abundant; and the inference that they are now gradually dying out, which leads to the probable conjecture that many of the late tertiary forms became extinct within the historic period. 4. The observations of the existence of limited tracts, usually of considerable depth, at various points in the British seas, the marine inhabitants of which are much more arctic in character than those generally diffused through this region.—*Athenæum*, No. 987.

IMPORTANCE OF THE CHARACTERS DERIVED FROM THE FINS OF FISHES.

Professor Agassiz has communicated to the Helvetic Society, some new observations which he has made on the Fins of Fishes. He showed, by many examples, the importance to zoology and palæontology of the characters afforded by the careful study of the rays of the fins, which have hitherto been represented in a uniform and altogether incorrect manner, in the best ichthyological works.—*Jameson's Journal*, No. 79.

ORDER AND CONSTITUTION OF STRATA.

Among the more important labours of the year, are the researches of Sir R. I. Murchison, in whose hands the Classification of those Strata that lie between the rocks (primitive, azoic) entirely destitute of fossil remains, and the uppermost members of the carboniferous system, takes the following form:—

1. Immediately upon the crystalline azoic rocks of Scandinavia lie the earliest sedimentary deposits in which traces of organic life have been discovered. These are the Silurian strata; with the maximum of their development in Wales, with a very subordinate development in Russia. Here the palæozoic system, or a system entirely distinct from that of the animal and vegetable remains of the proper secondary strata, begins—Protozoic.

2. Immediately upon the Silurian lies the Devonian system; with a subordinate development in Russia. In the Devonian series of Russia are found both the mollusca of the proper Devonian system of England and the fishes of old red sandstone of Scotland.

3. The coal formation.

4. A formation succeeding the carboniferous, of great development, and of the age of the magnesian limestone in England. This is the Permian formation; with the Permian formation the palæozoic period ends. Such is the generalisation given to those miscellaneous groups known under the name of magnesian limestone, old red sandstone, transition limestone, &c.

GEOLOGY OF NORTH AMERICA.

Mr. Lyell has read to the British Association, a paper "On the Delta and Alluvial Deposits of the Mississippi, and other points in the Geology of North America, observed in the years 1845-46." One of the leading points is, that the advance of the Delta has not been very rapid, as generally supposed. "Yet the whole period," says Mr. Lyell, "during which the Mississippi has transported its earthy burden to the ocean, though perhaps far exceeding 100,000 years, must be insignificant, in a geological point of view; since the bluffs or cliffs bounding the great valley (and therefore older in date), and which are from 50 to 250 feet in perpendicular height, consist in great part of loam, containing land, fluviatile, and lacustrine shells of species still inhabiting the same country."

The coal-fields of Alabama were next alluded to; from which

fossil plants have been procured, by Prof. Brumby and Mr. Lyell, of the genera sphenopteris, neuropteris, calamites, lepidodendron, sigillaria, stigmaria, and others, most of them identical in *species*, as determined by Mr. C. Bunbury, with fossils of Northumberland. This fact is the more worthy of notice, because the coal of Tuscaloosa, situated in lat. 33° 10′ N., is farther south than any region in which this ancient fossil Flora had previously been studded, whether in Europe or North America; and it affords, therefore, a new proof of the wide extension of a uniform Flora in the carboniferous epoch. Mr. Lyell, adverting to the opinion recently adopted by several able botanists, that the climate of the coal period was remarkable for its moisture, equability, and freedom from cold, rather than the intensity of its tropical heat, stated that this conclusion, as well as the oscillations of temperature implied by the glacial period, are confirmatory of the theory first advanced by him, in 1830, to explain the ancient geological changes of climate, by geographical revolutions in the position of land and sea. The lapse of ages, implied by the distinctness of the fossils of the eocene, cretaceous, carboniferous, and other strata, is such, that, were we to endeavour to give an idea of it, we must estimate its duration, not by years, as in the case of the Delta, but by such units as would be constituted by the interval between the beginning of the Delta and our own times.

Mr. Lyell concluded this discourse by announcing his corroboration of the discovery, recently made by Dr. King, at Greensburg, thirty miles from Pittsburg, in Pennsylvania, of the occurrence of fossil foot-prints of a large reptilian, in the middle of the ancient coal-measures. They project, in relief, from the lower surfaces of slabs of sandstone; and are also found impressed on the subjacent layers of fine unctuous clay. This is the first well-established example of a vertebrated animal, more highly organised than fishes, being met with in a stratum of such high antiquity.—(See an Abstract of this valuable paper, in the *Athenæum*, No. 987.)

GEOLOGICAL STRUCTURE OF AUSTRALIA.

THE following Sketch, by Mr. J. B. Jukes, has been read to the British Association. This document is chiefly drawn up from the author's own observations during four years, in which he had opportunity, as naturalist of H.M.S. Fly, of seeing the greater part of the Australian coast.

Aong the eastern coast there is one continuous line of hills, extending from Bass's Straits to Cape York in Torres Straits, a distance of 2,4000 miles; beyond which it is prolonged in rocky islands up to the coast of New Guinea. This chain has a granitic axis, flanked by metamorphic and palæozoic rocks in the south, as described by Count Strzelecki. From Port Bowen, in lat. 22° 30′, the author's own observations commenced. The coast everywhere consisted of schists, porphyries, and basalts; at Cape Upstart granite occurred, and was extensively developed on the coast to the northward, and far into the interior, forming hills 4,000 feet high. North of Cape Melville, the

granite almost disappeared; and instead, great masses of porphyry, with feldspathic, quartzose, and metamorphic rocks, composed all the headlands and islands. This line of coast appears to cut obliquely through a chain having granite for its axis, flanked by porphyries and metamorphic rocks. On the south-east coast, the crest of the main chain lies 70 or 100 miles from the shore, leaving a considerable space, which is occupied by stratified rocks, consisting of palæozoic shales, sandstones, &c. The same rocks are found on the western flank of the chain, in the district of Port Phillip, and its coal-beds exist at Western Port. On the south-east coast granite shows itself in the bed of the Bogan, just before it enters the Darling, and in the upper parts of the Glenelg. South of the Murray, it forms the north and south ranges of the Pyrenees, the range of Mount Byng, &c. The great mass of the Grampians, more than 4,000 feet high, is composed of sandstone similar to that of Sydney; south of which are a number of volcanic cones and vast sheets of lava. Over all the lower parts of the country, from Port Phillip to the Murray, is spread a great tertiary formation, abounding in shells, echinoderms, and corals. At Cape Jervis, South Australia, the rocks consist of mica-slate, gneiss, and clay-slate; and at Adelaide, of coarse chlorite schist; and about Gawler Town, blue clay-slate prevails. Veins of copper and lead abound in the various ranges.

The interior appears to consist everywhere of tertiary clays and sandstone; which also form the coast, for 600 miles, from Streaky Bay on the east to Mount Ragged on the west of the Great Bight. About Mount Ragged granite is again seen, and frequently forms hills to the west, whose bases are concealed by the tertiary. From King George's Sound, an elevated district runs northward at least 250 miles, consisting of granite, metamorphic rocks, gneiss, &c. Between this district and the sea is a low plain, 20 miles wide, of recent tertiary rocks, which extend northward to the islands forming the western boundary of Shark's Bay, forming the whole western coast of the Swan River Colony. Along the north-west coast from Shark's Bay to Dampier's Land is a vast tract of flat country, scarcely raised above the sea level, and fronted by dunes of sand. Between Collier's Bay and Cambridge Gulf is a great promontory of stratified sandstone, like that of Sydney.

The next portion of the coast described from personal observation is that at Port Essington, which consists of a red or white ferruginous sandstone, horizontally stratified. This formation seems also to extend round the whole Gulf of Carpentaria, as far as the Victoria River. The sandstone abounds in ferruginous concretions, which sometimes compose its entire mass, which then looks like the refuse of an iron-furnace, or part of a lava-stream. These masses form the headlands and projecting points of the cliffs. On account of their similarity to the tertiary sandstones of Port Phillip, the author infers their similarity in age. In concluding, the author remarks the parallelism of all the known mountain chains in Australia, the majority being N.N.E. and S.W., and none varying more than two points from north

and south. He also cites the opinion of Capt. Sturt, that one vast desert plain stretches from the Great Australian Bight to the Gulf of Carpentaria; and observes, that the only great extent of country unaccounted for is on the north-west side, where the range between Cambridge Gulf and Buccaneer's Archipelago may rise into some importance in the interior.—*Athenæum*, No. 987.

SEPARATION OF ENGLAND FROM THE CONTINENT.

A PAPER, by Prof. Forchhammer, "On Sea-Water, and its Difference in various Currents," having referred the separation of England from France to physical features, such as the various changes which the Rhine and the Scheldt suffer at their mouths, has given rise to a discussion in which Sir H. De la Beche contends that the separation of England from the continent has not been a violent movement, but one brought about by causes operating during a long period of time: breakers must have been chiefly instrumental in removing the materials which once filled up the Channel. Dr. Buckland also doubts whether the separation of the Straits of Dover have taken place within the historic period. Mr. Lyell states that there have been several oscillations of level since the present chalk cliffs existed, which must have been considerable, since it allowed of the formation of the elephant bed at the base of the cliffs at Brighton, in which the remains of that animal are imbedded, together with those of whales. He considers the period of separation from the continent not historical, but indefinitely remote. Mr. Forbes remarks, that Prof. Forchhammer seems to have confused the deposits of several distinct periods. In many parts of this country, and in Ireland, there are beds of sand and clay containing shells of molluscous animals mostly now inhabiting our seas, but very inferior in number to those now living, and equivalent to the group now found on the coast of Labrador. Above these are the submerged forest, and higher still another series, such as have been discovered in the basin of the Clyde, containing an assemblage of fossils, all recent, and many of them eminently characteristic of the present climate.—*Athenæum*, No. 987.

THE SUBCRETACEOUS STRATA.

DR. FITTON has communicated to the British Association, a paper "On the Arrangement and Nomenclature of some of the Subcretaceous Strata," containing a summary of the latest inquiries upon the subject, and a tabulated arrangement of the species in a new collection of fossils, made by the author, in the dissections near Atherfield, from the gault down to the weald clay. After the enumeration, Prof. E. Forbes stated that there were two points in the present inquiry:—First, what correspondence there was between these beds in the Isle of Wight and those of the continent? and secondly, what name should be given to them, and on what principle? The answer to the first question mainly depended on the fossils. We possessed all the equivalents of the lowest cretaceous system; and if anything more existed abroad, it was only a portion of what we had in England,

and could not be separated under a distinct name. The principal difference between the Fauna of the continental Neocomian and the English lower greensand, depended upon the abundance of Gasteropods and Cephalopods in the former, and of acephalous bivalves in the latter. He objected to the terms upper and lower greensand, as implying a relation which did not exist, and recommended the adoption of new names. Captain Ibbetson remarked, that the beds of upper greensand in the Isle of Wight were unconformable to, or had a different inclination from, those of the lower greensand. Mr. Austen argued in favour of the adoption of the term Neocomin, contending that it was not a mere question of names, but regarded the physical condition of the globe at a certain period, the distribution of its land and water, and of the animals which inhabited it. The lower cretaceous strata had been deposited in the deeper part of the sea which followed the Wealden period. The lakes and estuaries of the Wealden were necessarily their deepest parts; and the Neocomian beds always rested upon Wealden, whilst each succeeding stratum occupied a wider area, and overlapped its predecessors. We were only on the edge of the cretaceous series, and might still detect in Dorsetshire shingle beds, marking the sea-beach of that period. The whole cretaceous system of England was but a part of a formation having a vast geographical range, and presented very exceptional characters: so that we could not claim to consider our series the type to which all others should be referred.—*Athenæum*, No. 986.

GEOLOGICAL DISTRIBUTION OF FOSSIL PLANTS.

M. ADOLPHE BRONGNIART observes:—"The living vegetable kingdom consists of five great divisions: the *Cellular Cryptogams*, or *Amphigens*; the *Vascular Cryptogams* or *Acrogens*; the *Dicotyledonous Phanerogams*, *Gymnosperms* and *Angiosperms*; and the *Monocotyledonous Phanerogams*. Of these five divisions the three first evidently existed at the carboniferous epoch; whereas the two last seem to have been entirely awanting: there is nothing, at least, which establishes with certainty their existence, and everything, on the contrary, tends to render it doubtful.

Again—"At the epoch of the coal deposits, the vegetation must have consisted solely, or almost solely, of two of the great branches of the vegetable kingdom: the *Acrogenous Cryptogams*, represented by the herbaceous and arborescent ferns (the latter reduced to the true *Caulopteris*) by the *Lepidodendrons*, a family approaching to the *Lycopodiaceæ*, and by some *Equisetaceæ*; and the *Dicotyledonous Gymnosperms*, including the *Sigillariæ (Sigillaria, Stigmaria, Lepidofloyos)*, the *Calamitace (Calamites)*, the *Coniferæ (Walchia)*, and probably the *Asterophylleæ (Asterophyllites, Annularia, Sphenophyllum.)* We thus see the importance this last mentioned division of the vegetable kingdom seems to have had at a remote epoch, while we know how limited it is in the vegetation of the present day.—*Comptes Rendus: Jameson's Journal*, No. 80.

SUMMARY OF FOSSIL PLANTS.

M. Goeppert observes:—"No statement has been published since 1828 of the number of the known species of fossil plants. M. Adolphe Brongniart enumerated 500 species in his classical work. This number is now nearly quadrupled; for I myself am acquainted with 1792, which belong to 61 families, and 277 genera. I mentioned 253 species of ferns in the monograph on that family, which I published in 1836; but I am now acquainted with more than 524 species. If, without exaggerating, we estimate the known number of species of living plants at 80,000, the fossil Flora, so far as it has been ascertained, amounts to 1-45th of the living Flora."—See the Summary, or Table, in *Jameson's Journal*, No. 80.

GEOGRAPHICAL DISTRIBUTION OF EXTINCT MAMMALIA.

This valuable paper has been communicated by Prof. Owen to the British Association. The Professor announced his purpose to develope the law or principle on which mammals are, and have been, distributed over the surface of this planet. (A mammal was described as being characterized by a hairy skin, quick respiration, and, therefore, a temperature usually higher than that of the surrounding atmosphere, and by bringing forth living young.) He stated that recent researches had led him to defined views on the following subjects:— 1. *Comparative development as between mammals of the old and new world.* 2. *Peculiarities of mammalian distribution in Australia and the neighbouring islands.* 3. *Probable final causes of several instances of this development.* 4. *Inquiry whether the extinct species of mammals were localized like the present races.*

Thus,—1. *On the comparative mammalian development in the new and old world of geographers.*—The Professor stated that, in the old world, mammals reached their highest type. Among other illustrations of this truth, he contrasted the lion and royal tiger of Asia and Africa, with the puma and jaguar of America; the large and useful camel with the feeble vicugna. The most remarkable of the herbivorous and pachydermatous animals, as the giraffe and the antelope in the former class, and the elephant, rhinoceros, hippopotamus, baboussa, horse, djiggitas, zebra in the latter, are peculiar to the Old World. With respect to the rodent animals, water-rats, hares, rabbits, tailless hares, are only found in the Old World. The beaver is, indeed, represented by an American species, but this is distinct from the beaver of the Danube. The monkeys of the Old World are equally distinguishable from those of the New. In the latter we find the prehensile tail, the wide and approximated nostrils, and the absence of an opposable thumb on the hand.

Professor Owen proceeded, 2dly, to *notice the peculiarities of mammalian distribution in Australia and the neighbouring islands.* In this tract of the globe all the animals are distinguished by two remarkable peculiarities, one positive and the other negative; (*a*) all are organized to carry about their young, from a very early period of embryonic life, in a portable pouch; and (*b*) none have attained a

high degree of development. The largest marsupial carnivora are the *Thylacine* and *Dasyure*, which are respectively of the size of the dog and the wild cat.

3. *Probable final causes of several instances of this development* were then adverted to. Thus, the marsupial inhabits a country liable to long-continued drought, and where the indigenous animals are consequently compelled to make long journeys in search of water; were it not for the arrangement enabling the marsupial to carry its young with ease from one place to another, the races would probably become soon extinct. The prehensile tail of the American marsupial, as well as of the porcupine, kinkajous, ant-eaters, and monkeys of the New World, have reference to their arboreal life in the huge forests in which these creatures live. Then, to prevent mischievous effects from the decomposition of vegetable matter in countries where it is so luxuriant, decaying plants furnish food to *Termites* and other insects, which, in their turn, support a peculiar genus of quadrupeds, the *Myrmecophaga*, (or ant-eaters.) In closing this part of his subject, the Professor noticed the armour-like, osseous skin of the armadillos, which live at the foot of trees, and are, therefore, extremely liable to blows from falling boughs, &c. In other parts of the world, where vegetation is abundant, the quadrupeds related with it are generically distinct from those of South America. This adaptation of species to locality having impressed itself strongly on his mind in regard to the present globe, the Professor stated, that he early applied himself to inquire whether—

4. *The extinct species of mammals were localized like the present races.* For this purpose he formed a full and correct catalogue of the fossil remains of mammals in our island. He then gave a rapid sketch of the successive races of the extinct mammals, as they have been traced by the fossils in the ascending series of strata in England and Scotland. The first examples of this class are found in the limestone slate of Stonesfield, at the base of the middle oolite. These fossils were remains of small insectivorous, and probably marsupial, quadrupeds, associated with remains of beetles, vegetable fossils, shells, and fishes allied to the *Cestracion*. These recal many of the characteristic features of actual organic life in Australia. During the long period which followed the formation of the Stonesfield slate, and which has permitted the subsequent, successive, and gradual accumulation of enormous masses of sedimentary rocks, viz. great oolite, cornbrash, forest marble, Oxford clay, calcareous grit, coral rags, Kimmeridge clay, Portland stone, Wealden, gault, greensand, chalk, no trace of a mammalian fossil has been found. In England we first obtain evidence of that class of animals in the debris of some continent, poured out by vast rivers upon the surface of the chalk, forming masses 1,000 feet in depth—the Plastic and London clays. Here are remains of great *Tapiroids*, as *Lophiodon* and *Coryphodon*, and smaller *Pachyderms*, like Peccaries—*Hyracotherium*. Here, with boa constrictors, are turtles, sharks, fossil palms, and other forms of tropical vegetation. At the same period there were alternating fresh

water and marine deposits in continental Europe, filling up a vast ex-cavation of chalk, called the Paris basin, and forming the foundation on which that city is built, analogous to the clays on which London stands. Here Cuvier first discovered and described the *Anoplothere*, *Palæothere*, and *Chæropotamus*.

The Professor then briefly noticed the existence of similar calca-reous freshwater and marine deposits in the Isle of Wight, and ad-verted to the discoveries of Mr. Allen and Mr. Pratt. It was, how-ever, remarked, that little is gained by comparison of eocene and existing mammals, excepting so far as these indicate a great change in the distribution of earth and sea, and an accompanying alteration of climate. With the last layer of eocene deposits, we lose in Eng-land every trace of the peculiar mammals of that period. A vast series of geological operations took place, from which the meiocene strata resulted, before this country was again in a condition to sustain ether mammalian races. Of these intermediate operations, and of the contemporary mammals, we have only the evidence of continental geology. We have in this country traces of one species of mastodon, found in the meiocene crag-deposits of Norfolk. In process of time, when this island had become the seat of freshwater lakes, in which molluscous shells were deposited, and during the changes which con-verted lakes into river-courses, there were in these deposits, and in contemporaneous local-drifts, remains of mammalian Fauna: the mastodon had disappeared; but, of the *Ungulata* were traces of mam-moth, rhinoceros, hippopotamus, urus, bison, bos, *megaceros*, *strongyloceros*, *hippelephas*, reindeer, roe, horse, ass, wild boar;—of the *Carnivora*: lion or tiger, *Machairodus*, leopard and cat—hyæna, bears, wolves, and foxes, badger, otter, polecat, weasel;—of the *Insectivora*: bats, moles, and shrews, *palæospalax* (large shrew mole, now extinct); of *Rodentia*: beavers, hares, rats, and mice, lagomys (*Trogonthere*, extinct);—of *Cetacea*: cachelot, narwhal, grampus, whales.

The Professor then demonstrated, by the following proofs, that these remains had not been brought hither by any sudden and tran-sient convulsion, but were relics of animals which had lived and died in this island in successive generations. 1. Vast numbers are found in tranquil freshwater strata. 2. The condition of the bones is not as if they had been triturated by the violence of waves, but their pro-cesses are perfect, and their outlines sharp and well-defined. 3. The great proportion of antlers proved to have been naturally shed, and these of different stages of growth, to the fossil bones of the deer, proves, beyond question, that generations of this animal must have passed their existence here. 4. The *koprolites*, and other phe-nomena of Kirkdale Cavern, described by Dr. Buckland.

Anticipating the question—how so many races of quadrupeds, now extinct, could have found their way hither, Professor Owen gave a brief outline of the geological and zoological evidence, that England once formed a part of the continent from whence they came. The British Channel is, geologically speaking, of recent formation. At

the time when England became an island, it is probable that the mammoth, rhinoceros, hippopotamus, &c. became extinct. This, though at a geologically recent period, was long before any historical records existed. Professor Owen adverted then to Dasmarest's arguments in confirmation of this opinion, derived from the specific identity of the wolf and the bear of France, with the same animals historically known to have once infested our island: and he maintained that the races of some of our most familiar animals were coeval with the *mammoth*: two species of bats, mole, badger, otter, fox, wild cat, mouse, hare, horse, red deer, roe; and, on the continent, the rein-deer, beaver, wolf, *lagomys*; the aurochs of Russia, identical with an animal of the same kind in England.

In the New World, the same correspondence is singularly illustrated by the coincidence of the peculiarly zygomatic process and the dentition of the megatherium with that of the still living sloth. The *armadillo* of South America is also similar to the high fossil *glyptodon*. North America had its peculiar species of mastodon; but, being connected with South America at its apex, and with Asia, by frozen seas, at its base, in accordance with this geographical condition, it was found that the mammoth of the Old World had migrated from the north, and the megatherium from the south, and that both had met in middle temperate regions of that continent. The fossil mammals of the newer tertiary period of Australia belong to the marsupial genera of *Kangaroo*, *Phalanger*, *Dasyure*, wombat, &c., peculiar to the same country at the present day, but represented by species as big as the rhinoceros. A more remarkable example of the concordance of the existing and last extinct races of warm-blooded animals, was afforded by the small peculiar and wingless bird (*Apteryx*) of New Zealand, and the extinct gigantic birds (*Dinornis*) from the superficial deposits of the same island. No remains of fossil quadrupeds have yet been found in New Zealand; and this country possessed no marsupial or other species of aboriginal quadruped when discovered by Captain Cook. From these and similar facts, the Professor drew the conclusion, that the same peculiar forms of mammal quadrupeds and terrestrial birds were restricted to the same natural provinces at the later tertiary period as at the present day. And as a corollary, that the same general disposition of the larger bodies of land and sea then prevailed as at this time. On the other hand, in carrying back the comparison of recent and extinct quadrupeds to the earlier tertiary period, indications were obtained of extensive changes in the relative position of land and sea; and, consequently, of climate: and that the deeper we penetrate the earth, or, in other words, the further we travel in time for the recovery of extinct mammals, the further we must travel in space to find their existing analogue. The *Tapir* of Sumatra or South America is the nearest living analogue of the eocene *Lophiodon*, and the marsupial insectivores of Australia have, of all known animals, the nearest resemblance to the fossil *phaseolotherium* of our English oolites.—*Athenæum*, No. 955.

FOSSIL MAMMALIA OF SOUTH AMERICA.

PROF. OWEN has communicated to the British Association, notices of some Fossil Mammalia of South America, which had come under his observation since the publication of his descriptions of the fossil mammalia collected by Mr. Darwin.

Thus, a new species of the gliriform genus of Pachyderms called Toxodon, was founded on an entire lower jaw, with the intermaxillary part of the upper jaw of a specimen equalling the *Toxodon platensis* in size, transmitted from Buenos Ayres. The new species, which Prof. Owen proposed to call *Toxodon angustidens*, is distinguished by the nearly equal size of the upper incisors, the transverse diameter of the inner or median one being two inches; and by the narrower transverse diameter of the inferior molars. Prof. Owen considered the evidence he had induced as evidences of a second species of Toxodon; confirming, in every respect, his ideas of the affinities of the genus expressed by the title, "Description of the cranium of the *Toxodon platensis*, a gigantic extinct mammiferous animal, referable to the order *Pachydermata*, but the affinities to the *Rodentia Edentata*, and herbivorous *Cetacea*," under which his original memoir was published in 1838. M. Quatrefages, in his "Considérations sur les caractères Zoologiques des Rongeurs," 4to. 1840, had corrected what he assumed to have been Prof. Owen's allocation of the Toxodon to the Rodent order. M. Quatrefages thought the so-called incisors of the Toxodon to be canines, affirming that their roots extended to the maxillary bones above the first molars; he regards the Toxodon as having a nearer affinity to the Morse (Trichecus). Prof. Owen referred to his "Odontography," p. 411, for a refutation of Geoff. St. Hilaire's ideas that the scalpriform incisors of Rodents were canines: and alluded to the enamelled complex molars of the Toxodon in refutation of M. Quatrefage's idea of its relationship to Trichecus.

An almost entire skull of the *mastodon Andium* had been transmitted to the British Museum from the post-pleiocene beds of the Pampas of Buenos Ayres; its molar dentition was described, and a distinctive character of its tusks, in a strip of enamel two inches broad along their outer sides, was pointed out.—Macrauchenia. To this genus of tridactyle Pachyderms, which is nearly allied to the Palæotherium by the structure of the feet, and the Llamas (Auchenia) in the structure of the neck, Prof. Owen had referred a molar tooth of the lower jaw, on account of its crown being composed of two upright half cylinders of equal height, as in the Palæotherium. A left ramus of the lower jaw, from tertiary deposits of Buenos Ayres, has been received, containing six molar teeth, three true and three false, the last four showing the same form or pattern as the single fossil tooth from Patagonia, demonstrating the resemblance with the lower molar teeth of the Palæothere, except in this difference, viz., the absence of the third lobe in the last molar, by which the generic distinction of the South American Pachyderm was established; and an approach made to the rhinoceros. The Macrauchenia, to which Prof. Owen provisionally referred the fossil in question differed, however, like the

Palæothere, from the rhinoceros, in the greater exterior convexity and the equal height of the two demi-cylindrical lobes of which the last premolar and the three true molars were composed, and it further differed from both Palæothere and rhinoceros in the more simple form of the second and third premolars; the enamel is smooth and the dentine is compact, and the coronal cement forms a thin layer. The longitudinal extent of six molar teeth was nine inches.—Nesodon, n.g. A genus allied to the preceding, but resembling the Anoplotherium, in the absence of any vacant interspace in the entire dental series, and in the equal height of canines and incisors, was established on the anterior part of the lower jaw and on two molar teeth of the upper jaw, discovered by Capt. Sullivan in an arenaceous tertiary deposit on the coast of Patagonia. The incisors, canines, and premolars of the lower jaw, are not only in contact, but overlap each other like scales or tiles, and the molar teeth of both upper and lower jaw are characterized by islands of enamel; whence the generic name proposed. The incisors are six in number. The characters described by Prof. Owen are resemblances to Toxodon, in which, also, the large procumbent incisors overlap each other; the interval between Toxodon and Macrauchenia is evidently partly filled by the present remarkable genus. The extent of the sloping symphysis, the breadth of the lower jaw behind the symphysis, and the depth of the ramus at the beginning of the first true molar, were severally two inches. The quadruped to which these fossils belonged must have been about the size of the llama. Prof. Owen proposed to call the species *Nesodon imbricatus*, in allusion to the tile-like, overlapping arrangement of the anterior teeth. A second larger species of Nesodon was indicated by four or five detached teeth of the lower jaw from the same deposits. This species, of the size of the zebra, it was proposed to call *Nesodon Sullivani*.

As a check to the undue increase of so many large herbivorous species of the Megatherioid and Pachydermal orders, the great Machairodus, discovered in the caves of Brazil, by Dr. Lund, who first supposed it a hyena, was well adapted. An almost entire skull had been, thence, transmitted to Paris, and had been referred by M. de Blainville to the genus Felis; he had published a figure of it. A specimen of the same, or a closely allied species, displaying some characters not preserved in the Parisian specimen, had been transmitted from the tertiary deposits of Buenos Ayres. Prof. Owen pointed out several differences establishing the, at least, subgeneric distinction of this remarkable carnivora, which equalled the Bengal tiger in size, and had upper canine teeth of thrice the length. As Prof. Owen could not determine any specific distinction in the present fossil from the *Hyena neogea* or "Smilodon" of Dr. Lund, he proposed to call the species "*Machairodus neogæus.*" This, happily extinct, most formidable and destructive of the carnivorous genera, had anciently an extensive geographical range through a great extent of South America, in India, and throughout Europe: fossil remains of different species having been found in old pleiocene deposits in Germany and

France, in the newer pleiocene of the Val d'Arno, and in the bone caves of England. Our own ancient *Machariodus latidens* of Devonshire, added to the other species, enforces the propriety of keeping the genus distinct from the typical Felis. Of the gigantic extinct armadillos, Prof. Owen added to the former species, which he had called *Glyptodon clavipes*, the following: viz., *Glyptodon reticulatus*, *Glyptodon ornatus*, *Glyptodon tuberculatus*, and *Glyptodon clavicaudatus*. An enormous tail of the latter, now in the British Museum, showed several of the ossicles of the dormo-skeletal sheath produced into huge tubercles, the whole resembling the club of the giant Gog or Magog. Prof. Owen thought that the present knowledge of the co-existence with those large herbivorous armadilloes of a gigantic carnivorous species like Machairodus, gave some insight into their need of a complete and strong defence of all the exposed parts of the body and the tail, since they had not the powerful claws with which the Megatherioid quadrupeds might have waged war with the Machairodus. With regard to the Megatherium, the remains recently transmitted confirmed Prof. Owen's ideas of its closer affinity to the sloths than to the ant-eaters or armadilloes; and had enabled him completely to reconstruct both the fore and hind extremities, and correct all the errors in Cuvier's description.—*Athenæum*, No. 938.

FOSSIL QUADRUPEDS OF RUSSIA IN EUROPE.

FAR from being peculiar to the Ural Mountains and Siberia, the remains of Mammoths, and other lost Quadrupeds, have been found over very considerable regions of Russia in Europe. In Russia, as in every other great region which has been examined, the races of lost mammals present some types which connect her former lands with those of other countries, associated with forms which are peculiar to her. Thus, whilst, in common with America, Russia contains the *Mammoth* and *Mastodon*, and in common with Britain, the *Elephas primigenius*, *Rhinoceros tichorinus*, *Trogontherium*, beaver, bear, elk, &c., she once possesseed generic forms, as *Merycotherium* and *Elasmotherium*, which have hitherto been found elsewhere. Russia is, indeed, as peculiar in her possessions of the latter extraordinary pachyderm as South America is for the *Mylodon* and *Glyptodon*.—*Sir R. J. Murchison's* "Russia and the Ural Mountains."

THE BOS URUS (AUROCHS), OR PRIMEVAL OX.

OF all the remarkable quadrupeds which ranged over continents, one species only remains alive, (and this point, even, is doubtful), to connect the historic era, or the present outline of the land with that which preceded it. This is the *Bos Urus* (*Aurochs*), or primeval ox, whose bones are so frequently associated with those of the mammoth in different parts of Russia and many parts of Europe. But if the species be the same, how has this exception been made, and how have herds of these oxen been preserved in a living state? Looking at the forest of Bialavieja, in Lithuania, as the only locality in which this species now exists, and it is not far from the edge of the south granitic stepp e, known to be of the highest antiquity, Sir R. Mu

sen infers that it was never depressed beneath the waters since the beginning of palæozoic era, but escaped the submersions which affected all the surrounding regions of Russia in Europe. Some individuals of the *Bos Urus* may therefore, we conceive, have been dwellers in this granitic ridge, until the retirement of the surrounding waters enabled them, or their descendants, to repeople the new jungles and forests of the fresh formed ground: and thus we could explain, by reasoning from geological appearances, how it happens that they are now found living in the forests of Lithuania.

Notwithstanding the deep interest attached to the *Bos Aurochs*, there did not, until very lately, exist a single skeleton or stuffed specimen of the species either in France or the British Isles. The Emperor Nicholas, at the request of Mr. Murchison, has, however, directed that a fine animal, selected from the unique herd now living in the forest called Bialavieja, should be killed, and his skin and skeleton sent to the Museum of the Royal College of Surgeons. It may not be known, that without a stringent ukase to prohibit its annihilation, the peasantry of Lithuania would long ago have exterminated this noble species.

THE EXTINCT IRISH DEER.

A VERY interesting discovery has lately been made in Ireland, of some Fossil Bones, which, according to a Correspondent of the *Dublin Evening Post*, is convincing proof that "the splendid and magnificent animal, the Giant Deer of Ireland, was domesticated by man for his use and food, and driven by him, in company with other cattle, to be killed or slaughtered in the same way or manner as the butchers of the present day do, by breaking in the frontal bone of the face by some heavy or sharp instrument."

These remains were found in Loch Gûr, a moderately-sized lake, having an island in the middle, near Limerick. They consist of various skulls and bones, among which are those of oxen, pigs, goats, the red deer, and the extinct Irish deer; and it is believed, for the first time in Ireland, the reindeer, &c.; but none of sheep—a singular fact; and going, in the opinion of a writer in the *Farmer's Gazette*, far towards furnishing an inference, that, at the period when these deposits were formed, the sheep had not become domesticated in Ireland. The quantity of the remains of *goats* deserves attention, the name of the lake, "Loch Gûr" or (Gour), signifying, in Irish, "Lake of the *Goats*."

Among the heads of oxen, are some chiefly remarkable on account of their prodigious size; others on account of their singularity of formation; but that which more immediately interested us was, that we found several skulls of a *short-horned breed of cattle*, similar in size and form to those animals which are now so highly prized in Ireland on account of their superiority over other varieties, but which are imported from England.

"*Here, then,*" (continues the *Farmer's* Gazette), "*in this vast depository of bones*, we discover sufficient evidence to prove, that we,

in olden times, possessed the true short-horned variety of cattle, if we can judge by the skeleton heads, which we are now compelled to import from the sister country; and we are almost authorized to infer, that it was to Ireland that England herself was originally indebted for the stock from which the "pure" short-horns are descended. The discovery of these remains demonstrates another and a particularly interesting fact, viz.:—that the Irish giant deer, sometimes improperly termed the Irish *Elk*, was co-existent with these short-horned cattle, was itself a domesticated animal, and was itself killed for human use; for we have to add the extraordinary fact that, amongst other fragments, we found the remains of several giant deer, and, amongst others, two female skulls fractured on the frontals in precisely the same manner as those of the cattle. We have the more pleasure in mentioning this fact, from the circumstance that it confirms, in the most unanswerable manner, the position advanced in Mr. Richardson's clever pamphlet on the fossil deer—positions in which Mr. Richardson stood alone at the time of their publication, and had to endure the opposition of some of the most celebrated savans of the day. Amongst others, we may mention Professor Owen, who maintained that not only was the giant deer not contemporary with man, but that he was created some thousands of years prior to the existence of man upon the surface of this globe. Mr. Richardson published his pamphlet in reply to the views advocated by Professor Owen; and whatever doubt might then have existed, as to which side the truth lay upon, we think that this remarkable discovery is amply sufficient to establish the correctness of Mr. Richardson's views, and to set this disputed question at rest *perhaps* for ever."

Another confirmatory fact is, that some years ago, a portion of the leg of an Irish giant deer, with a part of the *tendons*, *skin*, and *hair* upon it, was exhumed, with other remains, from a deposit on the estate of H. Grogan Morgan, Esq., of Johnstown Castle, county of Wexford, and is now in that gentleman's possession.

Mr. Nolan, of Bachelors' Walk, Dublin, has conveyed some specimens of these remains to London: they consist of an entire skeleton of the extinct deer; a head and horns of a small variety, much more rare than the large one, both in a perfect state; two heads of females of the extinct deer, with the skulls evidently fractured by the butcher, putting at rest (says Mr. Nolan) the long controverted point of their being recent or fossil. There are, likewise, a perfect female skull, and several varieties of the oxen, some extinct; and skulls of pigs, one extinct. We subjoin the measurements of one pair of horns:—

	Ft.	In.
Distance between the extreme tips, measured from the skull	14	6
Ditto in straight line across	12	10
Length of each horn	7	1
Breadth of the palm	1	7
Length of sur-antler	1	9

The horns are enormous in point of length; and, in their widest part, *i. e.*, of the palmated portion, so ample, that, to use the idea and expression of a carter, who looked on whilst an artist was sketch-

ing—"A man might sit on each horn well enough and no fear of falling off!" This idea is a very good one, and shows the breadth of the horns more explicity than any other which could be employed, as it at once suggests the familiar object of the seat of a chair by which to compare them.

One of the skulls is a very good specimen, and undoubtedly of a female, but the *supposed female* is a skull about which Mr. Nolan and Professor Owen are at variance. Mr. Nolan maintains it to be of a female deer, from its having no horns, or apparent roots of horns, and that the hole in the forehead was caused by a blow from a pole-axe. Professor Owen considers it to be of a male deer, or, as generally called, *Irish Elk*, and supports his opinion by the great thickness of the skull across the forehead, and its great width as compared to the other skull; and adds that it was never killed by a blow from a poleaxe, but that the horns have been wrenched or knocked from the skull by those who found it. The fracture would appear *old*, as the bone is so thoroughly impregnated with the colouring matter from the bog as to be dark throughout, and so could not easily be detected. Again, the outward form of the skull is in many points quite unlike the one acknowledged to be female; and Professor Owen having measured it, found the skull of the doubtful one to be much larger round the forehead, and near where the horns should be, than it could possibly be, *in proportion*, were it only the skull of a large female. With respect to the skull of the bull, its chief features are the short horns, showing, as we have already stated, that originally there was a short-horned breed in Ireland.—*Illustrated London News*, No. 242.

FOSSILS FROM THE COAL-FIELDS OF AUSTRALIA.

Mr. Morris has described the Fossil Plants brought by Count Strzelecki from the Coal-fields of New South Wales and Van Diemen's Land. Unfortunately, the materials were very scanty, the number of species being only eight; and it is singular, that of this number four are from the coal-field of New South Wales, and four from that of Van Diemen's Land, no one species having been found common to the two. Both these Australian coal-fields are very remarkably distinguished from those of Europe and North America by the entire absence of *Stigmariæ*, *Sigillariæ*, *Lepidodendra*, and *Calamites*. In this respect they agree with the coal formation of Burdwan in Northern India, to which, indeed, they have other points of striking similarity in the character of their vegetable remains. The *Glossopteris Browniana* is actually common to the coal formations of New South Wales and of India, and the *Pecopteris australis* of the former country comes very near to the Indian *P. Lindleyana*. The flora of the coal-fields of Australia has likewise a striking similarity to that of our Yorkskire oolites. *Glossopteris Browniana* is nearly allied to *Glos. Phillipsii*, *Pecopteris australis* to *P. Whitbiensis*, and *Pecopteris alata* to *P. Murrayna*. It is possible that the coal of Australia and of Northern India may really belong to the Jurassic system.—*The President's Anniversary Address* to the Geological Society, 1846.

THE DINORNIS.

Professor Owen has read to the Zoological Society, a Memoir (Part II.) on the Dinornis, descriptive of parts of the skeleton transmitted from New Zealand since the reading of Part I. Of this communication, the following is an abstract:—

The bones referable to species defined in that communication were first described. Among these were the cranial portion of the skull of *Dinornis struthoides* and a corresponding portion of the skull of *Dinornis droimoioides*, which in general form more resembled that part of the skull of the Dodo than of any existing bird; but they are remarkable for the great breadth of a low occipital region, which slopes from below upwards and forwards. The almost flat parietal region is continued directly forwards into the broad sloping frontal region; the temporal fossæ are remarkably wide and deep; the orbits small; the olfactory chamber expanded posteriorly, but not to so great an extent as in the apteryx: the plane of the foramen magnum is vertical. Many other characteristics in the cranial organisation of the genus *Dinornis* were described, and the specific distinction of the two mutilated crania pointed out.

The tympanic bone of the *Dinornis giganteus* was described in detail, and compared with the same bone in existing birds.

Different cervical and dorsal vertebræ, referrible to the species *Din. giganteus*, *ingens*, *struthoides*, and *crassus*, were described. These vertebræ were remarkably entire, and with some of the best-preserved bones of the extremities, described in a subsequent part of the Memoir, had been obtained from a turbary formation on the coast of the Middle Island, near Waikawaite.

One of the most interesting of the novel acquisitions from this locality was an almost entire sternum, referred by Prof. Owen to the *Din. giganteus*. It is a subquadrate, keelless, shield-shaped bone, broader than long, with the posterior angles and the xiphoid process prolonged, as in the Apteryx, but without the anterior emargination. The coracoid depressions very small. This bone was minutely described, and compared with the keelless sternums of the existing Struthious birds; that of the Apteryx being demonstrated to be most like the sternum of *Dinornis*.

A very remarkable femur and tarso-metatarsal bone, also from the Middle Island, were exhibited, belonging to an additional tridactyle species, to which the name of *Dinornis crassus* was given. Of this species, the author remarks: "With a stature nearly equal to that of the ostrich, the femur and tarso-metatarsus present double the thickness in proportion to their length. It must have been the strongest and most robust of birds, and the best representative of the pachydermal type in the feathered class."

The paper (which was illustrated by numerous figures) concluded by some general comparisons and remarks on the geographical distribution of the different species of Dinornis.

Prof. Owen has also communicated to the Zoological Society, as an "Appendix to his Memoir of the Dinornis," some observa-

tions on the skull and on the osteology of the foot of the Dodo *(Didus ineptus)*.

After a brief summary of the history of this remarkable extinct brevipennate bird, in which the reduced highly finished figure by Savery, in his famous painting of "Orpheus charming the Beasts," now in the collection at the Hague, was particularly noticed; and the recent discovery of the skull of the Dodo amongst some old specimens in the Museum of Natural History at Copenhagen was mentioned; Prof. Owen proceeded to demonstrate the peculiarities of the Dodo's skull, by a comparison of the cast of the head of the bird in the Ashmolean Museum at Oxford with those of other recent and extinct species of birds.

More satisfactory evidence of the affinities of the Dodo was obtained from a comparison of the bones of the foot, which have recently been very skilfully and judiciously exposed by the able Curator of the Ashmolean Museum.

Upon the whole, then, the Raptorial character prevails most in the structure of the foot, as in the general form of the beak, of the Dodo, compared with birds generally; and the present limited amount of our anatomical knowledge of the extinct terrestrial bird of the Mauritius would lead to support the conclusion that it is an extremely modified form of the Raptorial Order.

Devoid of the power of flight, it could have had small chance of obtaining food by preying upon the members of its own class; and if it did not exclusively subsist on dead and decaying organised matter, it most probably restricted its attacks to the class of reptiles, and to the littoral fishes, Crustacea, &c.

The author concluded by recommending search to be made for bones of the Dodo in the superficial deposits, the alluvium of rivers, and the caves in the islands of Mauritius and Rodriguez; little doubting that an active exploration would be as richly rewarded as similar investigations have been in the islands of New Zealand, by the recovery of the remains of the great extinct species of terrestrial birds which formerly inhabited them.

FISHES OF THE OLD RED SANDSTONE.

PROF. AGASSIZ has the following striking observations towards the close of his *Monographie des Poissons fossiles du vieux de rouge*:—

"From the whole of the facts above noticed, it appears to me to follow, that not only do the Fishes of the Old Red Sandstone constitute a distinct fauna independent of those belonging to other formations, but that they also present in their organization the most remarkable analogy to the earliest phases of the embryonic development of the osseous fishes of our own epoch, and a not less obvious parallelism with the lower degrees of certain types of the class as they now exist on the surface of the globe. This assemblage of fossil fishes *constitutes one of the* most interesting parts of the fauna of the old *red sandstone, as a* simple group of diverse but contemporary species. *Viewing it in this* manner, apart from all systematic considerations,

we are nevertheless struck with the great diversity which the species really present. Who would have expected that we should ever find, in spaces so limited as those which have hitherto been explored, above a hundred species of fossil fishes, in the devonian system alone, that is to say, in a stage of our formations which was believed a few years ago to be confined to the British islands, and to which, in consequence, only a local value was assigned? And yet, *ceteris paribus*, the ichthyological fauna which this formation contains is as considerable as that which inhabits the coasts of Europe; and, even although the species of the old red sandstone do not belong to so great a number of families as the living species, they are not less varied in their forms and general aspect, nor less curious in their external characters and organization, nor less different from each other in size and the degree of locomotive power with which they were, doubtless, endowed."

FISHES OF THE LONDON CLAY.

Prof. Agassiz has stated to the British Association, that since his last Report, the number of Fossil Fishes, known from the Paris basin, has increased; whilst few new forms have been obtained in the London clay. He had, however, been interested in the examination of specimens of teeth of the saw-fish, *Pristis*, and had noticed some curious changes which they underwent: during the growth of the animal, the young teeth were covered with enamel, and had a notch in their posterior margin; whilst, in old tusks, the bony material alone existed, and the margin was entire. On these grounds he considered the three species of Pristis described by Shaw (*P. semi-sagittatus*, *microdon*, and *cuspidatus*) as constituting in reality only one. Widely as these teeth differed in appearance from the flat, pavement-like teeth of the sting-rays (*Myliobatis*), their microscopic structure was identical; and Prof. Müller, of Berlin, had lately shown that the Pristis was not a shark, but belonged to the family of Rays. The Professor then pointed out a peculiarity in the construction of the ventral fins of the Mediterranean Goby, a fish which fixes itself to the bottom by its fins; that act also like springs, in enabling the fish to rise from the bottom. He expected soon to be enabled not only to discriminate every individual bone of any importance in the skeleton of a fish, but also to distinguish the separate fin rays. M. Agassiz then made some general remarks on the geographical distribution of recent fishes. There were many families—of which the flying-fish (*Exocœtus*) was an example—which were found equally in the Indian, Pacific, and Atlantic Oceans. Others, like the sharks and rays, were found in every sea from the Arctic circle to the Tropics, but the species differed on each coast; whilst some families were confined to the Indian seas, and co-extensive only with the great land animals of that region. The Goniodontes were peculiar to the fresh waters of South America; but these were connected with Ganoides of North America; and these again closely allied to the sturgeon, whose affinities have hitherto been little understood. We have here con-

fined to the New World all the representatives of an order widely dispersed over the ancient strata. Looking at the distribution of particular species, like the Silurus, confined to the Danube, Rhine, and a few other freshwaters of Europe, it might be asked by what means it had wandered from one locality to another? to which he would reply, that these freshwater fish must have been created in the very streams in which they now live, and in the same proportion as now. They leave the egg in so short a time, it was quite impossible they should be transported by birds or otherwise. The fishes in the Paris basin appeared to have lived on a coral reef or rocky bottom, whilst those of the London clay were such as in existing seas are found in shallow seas and muddy waters.

Dr. Buckland supported the view of Prof. Agassiz, respecting the origin of the distribution of freshwater fishes; and remarked the improbability that any herbivorous animals were created in pairs only, as they would soon have been exterminated by the carnivorous species. He believed that not only were groupes of species created where they are now found, but multitudes of individuals of each species.—*Athenæum*, No. 988.

TRILOBITES.

The attention of several distinguished naturalists has lately been directed to the investigation of the structure and classification of Trilobites. A valuable work on these singular extinct crustacea has been lately given to the world by Professor Burmeister, who is now revising an English translation of it, to be published by the Ray Society. In this work there is a systematic arrangement of all the species known to the author, and there are dissertations of great value on their organization. M. Emmerich has also published a very important memoir on the structure of Trilobites, a translation of which has lately appeared in Mr. Taylor's "Scientific Memoirs." In Sweden, Professor Löven, a naturalist distinguished for his researches among the invertebrate animals, has commenced the investigation of the Trilobites of that country with great success. His papers may be found in the Proceedings of the Swedish Academy for 1844 and 1845. All the memoirs now enumerated are illustrated by excellent plates. Lastly, in the "Geology of Russia," will be found an interesting note on the affinities of Trilobites, by Professor Milne Edwards.—*President's Anniversary Address to the Geological Society.*

FOSSIL RADIATA.

The history of Fossil Radiate Animals has received one of the most important additions ever made to it, in the memoir of M. von Buch on the *Cystideæ*,—a memoir of the greatest value to the naturalist, since it furnishes him with an elaborate and philosophical exposition of the organization and affinities of a group of fossil animals hitherto misunderstood, and which fill up a blank in the series of Radiata. As these fossils are now known to be by no means unfrequent in the British palæzoic strata, though they have hitherto attracted but little

attention, the study of the paper—itself a model of palæontological description—will well repay the attention of geologists. They will find it at full length, translated by Professor Ansted, in the *Journal of the Geological Society.*

REMAINS OF A FOREST ON WALLASEY LEA.

In cutting a tunnel from Woodside through Wallasey Plain, or Lea, the workmen have exposed a portion of the forest which formerly existed, and which has been covered to a depth of six or eight feet with a compacted bed of mingled sand and mud, the deposit of the sea, which evidently for a long period flowed over it. Beneath this bed is a black mass, similar to a coal seam, about six feet in thickness, composed of decayed leaves, branches, bark, and trunks of trees, intermingled with hazel nuts, and the mast of other common inhabitants of the forests. Numerous entire stems have been found, principally of oak and birch. Most of the timber has, by ages of subjection to the action of damp, or rather wet, decayed to a black mass, which, though compacted by the superincumbent weight, still, as it was dug out, fell asunder, and shewed the original shapes; the roots, fibres, branches, and even leaves, being distinctly traceable, while the whole emitted a strong ligneous odour. On all sides, pieces of thick branches, more or less decayed, were picked up.—*Liverpool Albion.*

DISCOVERY OF A LARGE DEPOSIT OF BLACK BITUMINOUS COAL IN CHATHAM ISLAND, ONE OF THE GALAPAGOS.

About the middle of the valley, (says Dr. Coulter, in his *Adventures in the Pacific*,) my attention was attracted to the foot of one of the hills, where the earth had fallen down, and left exposed to view large black rocks. I went over and examined it, and found them to consist of coal in large quantities, and extending away under the hills. As I was fatigued, I prepared my encampment for the night, and my meal, and which, to test my discovery, I cooked on a wooden spit before a fine fire of coal: it quickly ignited, flamed up, and burned after the cheerful manner of Cannel coal. I was greatly pleased with this useful discovery. There were great hills of it; and an immense supply could be here obtained, if there was a sufficient arrangement to convey it to the sea-side.

This fact (says Dr. Jameson, *Journal*, No. 80) we consider of importance, as connected with the proposition of steaming across the Pacific Ocean.

COAL OF INDIA.

There has been presented to the British Association, a "Notice of the Coal in India, being an Analysis of a Report communicated to the Indian Government on this subject," by Professor Ansted. The coal districts of India described in this report are five in number, three in Northern India and one in Cutch, whilst the fifth includes the province of Arracan and the coast of the Birman Empire near Tenasserim. The coal of Cutch is not of the carboniferous epoch,

is of little importance, and unpromising. The great series of coal-fields of Northern India extends from Hoosungabad, and the Nerbudda river (lat. 23° N. long, 78° E.) in a N. E. direction for 400 miles, to Palamow; thence eastward, for 250 miles, to Burdwan, near Calcutta, and again northwards, 150 miles, to Rajmehal, exhibiting a frequent out-crop of sand-stone shales and limestone, with occasional beds of coal of variable thickness and value. Commencing again on the flanks of the Garrow Mountains, near the Bramahpooter, and on the banks of that vast river, similar beds, also containing coal, extend in a north-easterly direction nearly 400 miles. It is thus possible that there exists a range of carboniferous strata for 1,000 miles along the base of the Himalaya Mountains, gradually becoming more distant towards the west. The Assam districts extend about 350 miles, chiefly the south-side of the Burhampooter: the commander of one of the Assam Company's steamers describes it as the best he ever used, and far superior to any in Calcutta. The Tenasserim and Arracan coal districts are important for their near vicinity to Malia: in the former is coal which promises well for gas. The whole is, probably, of the tertiary period. Col. Sykes observed that it was of importance to obtain coal for the proposed railways in India, especially as wood was beginning to be scarce in many parts. The Report mentioned the occurrence of coal at 90 localities,—most of them in a bed between the Nerbudda and Calcutta. With a trifling exception, the whole of India south of this line was destitute of coal.

AIR OF MINES.

M. Leblanc, on analysing the air of Poullavuen mine, finds that when most altered by respiration and combustion of lamps, there is 3 to 4 per cent. of carbonic acid, and a diminution of 4 to 5 per cent. in the proportion of oxygen. The miners' lamps are extinguished; but by placing the meshes of two lamps in contact, combustion often goes on where one alone fails. The respiration of the miners is a little impeded, but work is possible when this limit is not exceeded, provided the temperature is low. Air collected at Huelgoet, in an unoccupied shaft, shewed a diminution of 10 per cent. in the amount of oxygen, without a replacement of the same by carbonic acid, which circumstance he attributes to the influence of decomposing pyrites.—*L'Institut; Silliman's Journal.*

LITHOGRAPHIC STONES.

A new locality, affording a superior quality of Lithographic Stone, has been opened at Belbèze, Haute Garonne, in the French Pyrenees. According to M. Leymerie, they are inferior to none before known, being even superior in hardness to the stone from Munich. This locality belongs to the cretaceous formation, while all previously discovered have been found in the jurassic system of rocks.—*L'Institut; Jameson's Journal*, No. 79.

GRADUAL RISE OF NEWFOUNDLAND ABOVE THE SEA.

It is a fact worthy of notice, that the whole of the land in and about the neighbourhood of Conception Bay, very probably the whole island, is rising out of the ocean at a rate which promises, at no very distant day, materially to affect, if not to render useless, many of the best harbours we have now on the coast. At Port-de-Grave, a series of observations have been made, which undeniably prove the rapid displacement of the sea-level in the vicinity. Several large flat rocks, over which schooners might pass some thirty or forty years ago with the greatest facility, are now approaching the surface, the water being scarcely navigable for a skiff. At a place called the Cosh, at the head of Bay Roberts, upwards of a mile from the sea-shore, and at several feet above its level, covered with five or six feet of vegetable mould, there is a perfect beach, the stone being rounded, of a moderate size, and in all respects similar to those now found in the adjacent landwashes.—*Newfoundland Times.*

AMBER, AND THE ORGANIC REMAINS FOUND IN IT.

Prof. Pictet has communicated to the *Bibliothèque Universelle*, an important paper, in which he refers to a large work upon this subject, now publishing by M. Berendt, under the auspices of the Queen of Prussia; and M. Pictet has availed himself of this source to give a general idea of the nature of Amber, its formation, and the principal features of the faunal flora whose remains are inclosed in it.

We have not space for the details of the organic remains discovered; but we may state that about 800 fossil species of insects occur in Amber; and Prof. Pictet concludes by observing that the Articulata appear to be the only division of the animal kingdom of which amber has preserved sufficiently numerous remains to throw some light on their history. With regard to the Mammifera, nothing else has been found in amber connected with them than tufts of hair, one of which, examined by a microscope, appears to have belonged to a bat. The feather of a bird has likewise been found. Among the Mollusca nothing further is mentioned than a few small shells perfectly preserved.

We should mention that as regards the climate of Europe during the epoch when amber was formed, the great number of Termes, and the presence of some species belonging to the warm zones of the globe, would *seem* to indicate that the temperature has been higher than it now is, and that the north of Prussia must have been placed in conditions intermediate between those which now characterise it and those of the basin of the Mediterranean. We recommend the student of palæontology to refer to the entire paper by Prof. Pictet, translated in *Jameson's Journal*, No. 82.

FOSSILS FOUND IN 1846.

Human Fossil.—Mr. Lyell, in a letter to the *Times*, gives a description of the place where the Bone of a Human Pelvis is stated to have been found near Natchez, in America; the gist of which goes to repudiate the discovery as a foundation for geological science to rest upon, and

ascribes the fact to an accidental deposit from superior strata on the banks of the ravine, among the débris at the bottom of which the fossil bone was declared to have been deposited.

Plesiosaurus.—On the estate of Mr. W. Layton, near Ely, in a railway cutting, have been found the fossil remains of the above creature of the old world. The workmen, in their ignorance of this treasure, broke to pieces and dispersed the head, neck, and trunk; but one of the paddles and about 10 feet of the tail will, it is expected, be tolerably perfect. The entire length is supposed to have been from 25 to 30 feet.

Mr. Stutchbury has described a new Species of Plesiosaurus (*P. megacephalus*) from the Bristol Lias, in the Bristol Museum. It is in very beautiful preservation, and exhibits some peculiar characters both in its general structure and proportions. Its length is about 16 feet 3 inches; the neck being short in proportion, and only one and a half times the length of the head: while the whole animal appears to have been remarkably compact and massive, and the extremities unusually gigantic. The teeth are large, and as many as 60 can be counted. The number of vertebræ is 94, comprising 29 cervical, 34 dorsal (and lumbar ?) 31 sacral and caudal.

Frog in Coal.—The *Edinburgh Weekly Register* gives an account of a small lively Frog found in the heart of a piece of coal, in a pit near Linlithgow. Its cell was exactly the form of the inhabitant, whose legs were twice as long as those of the common frog; its colour bronze, and it leaped briskly about as soon as liberated from its confinement.

Mexican Fossils.—In a letter to Prof. Bronn, M. Claussen states, that he has found in Brazil a great many Fossil Bones, and among them the head of a large tiger related to *Felis megantherecn* (*Ursus cultridens*), but it is much larger; the upper canine teeth are nearly ten inches long and 1½ broad. The French Institute has purchased it for 4,000 francs. The remainder of the collection, except the duplicates, has been disposed of to the British Museum. He promises subsequently to communicate some remarks on the occurrence of these fossil bones, and especially on that of the human remains, which are found among the bones of various extinct animals. He has discovered two kinds of monkeys, which approximate to the genera *Mycetes* and *Cebus*.—*Ann. Mag. Nat. Hist.*

Port Phillip.—A quantity of fossil remains from the small salt lakes between Bolac and Coranagamite, have been exhibited. One peculiarity of these remains is, that all the interstices are filled with numbers of minute shells, some in fragments, and others entire. The bones are so plentiful in the locality in question, that a person on the spot might soon obtain a complete skeleton of the unknown animal.—*Port Phillip Patriot.*

TORQUOISE MINE.

A RUSSIAN Company has obtained from the Persian Government,

for a small annual payment, the privilege of working the Turquoise Mines of Nichapour, in the province of Khorassan. The stones found there are the finest in the world for quality and size. When these mines were first opened, the turquoise was found there of so large a size that it could be turned into a cup for the father of the reigning monarch.—*Mechanic's Magazine*, No. 1172.

BRAZILIAN DIAMONDS.

The Brazil journals announce that a negro lately found in the Diamond district of Bahia a rough Diamond weighing nearly an ounce. Its approximative value is £45,000, but it was sold by the finder for £35.

MINERAL WEALTH OF GREAT BRITAIN.

In the course of a lecture to the general classes of King's College, by Mr. Tennant, on Mineralogical Geology, the lecturer stated, that the annual value of the Mineral Produce of this country amounts to about twenty-five millions. Of this, £9,100,000 is from coals, £8,400,000 from iron, £1,200,000 from copper, £920,000 from lead, £400,000 from salt, £300,000 from tin, £60,000 from manganese, £35,000 from silver, £22,000 from alum, £8,000 from zinc, and £25,000 from the various other metals, as antimony, bismuth, arsenic, &c.

COPPER AND GOLD IN SOUTH AUSTRALIA.

The mineral wealth of this newly-colonized country was noticed in the *Year-book of Facts*, 1846.

No competent idea of the wealth so unexpectedly opened up in South Australia can be formed without comparing the value of the ores there found with that of similar treasures in other countries:—

"Average produce of the principal mines in the world:—

		£	s.	d.	
CUBA.	Cobre Mine.............average	11	9	1	per ton.
	Santiago	14	10	6	,,
	San José	12	11	9	,,
SOUTH AMERICA.	Chili (principally regulus)	29	13	6	,,
	Valparaiso ore	15	11	11	,,
	Copiapo	18	14	0	,,
	New Zealand	10	10	8	,,
Average produce of Cornish Mines		5	15	6	,,
Ditto Irish ,,		6	8	8	,,
Ditto of South Australian Mines:—					
	Montacute	13	11	2	,,
	Kapunda	24	15	3	,,

The average produce of the Kapunda mine is, therefore, at present the *highest* of any copper mine in the world."

We quote the above from Mr. Dalton's "South Australia and its Mines," published in June last; in which the author thus remarks:—"An already explored extent of country, abounding in metalliferous

deposits, of 150 miles in length, by upwards of 30 miles in breadth. The absolute fee-simple of the soil vested in the purchaser.—Unsurpassed richness of the ores found, whether copper, lead, or iron.—Unparalleled abundance of the ores in those mines already at work, cropping out at the surface of the ground.—Easy access to all parts of the colony, and unlimited supply of transport for bringing the ore to the port."

Later accounts, by Capt. Tyrrell, of the North Montacute Mine, state that, in a shaft undertaken for the discovery of copper ore, for the Victoria Mining Company, "the auriferous vein is described as 'about two inches big,' is composed of a rich ochreous *gossan*, more or less intermingled with native gold, in various forms, and of the most imaginable purity; some specimens having the appearance of what is called a 'dead gold,' and many portions possessing a high degree of brilliancy."

COPPER REGION ON LAKE SUPERIOR.

A LETTER, dated May 28th, from Detroit, states the explorations on Lake Superior prove to be beyond compare the richest Copper Region in the world; and four or five veins have, thus far, been discovered, which contain silver in sufficient quantities to render the mining highly profitable. Some of the copper ores carry with them 10 per cent. of silver; which would make its commercial value between 4,000 and 5,000 dollars per ton. The Eagle Harbour Company have come to a mass of native copper; they have "drifted" longitudinally about 90 feet, without finding its length; they have sunk down about four feet in places without finding its depth. Its average thickness is about 18 inches! The mass thus far uncovered is estimated at about 90 tons; and its commercial value, when raised and smelted, will exceed 25,000 dollars. Dr. Petit describes it as "commencing at the shore of the lake, with an open cut 12 feet wide, 85 feet long, 7 to 8 feet deep, in which is found this enormous mass of copper. The sheet, which is 90 per cent. pure copper, is in the centre, running the entire length of the cut, varying in thickness from 6 inches to 2 feet, having branches of from one to two inches in thickness shooting from it east and west, and varying in length from one to two feet. The interstices are filled with sand and trap rock, charged with native copper,—say 50 to 75 per cent.; also small masses of beautifully crystallized marcasite or spar, filled with what has the appearance of copper filings, being quite rich. This is what is called the copper rock, as unlike a rock as possible. It looks more like a large tree that had fallen and turned to metal, with this exception that its depth is not in proportion. Large detached masses of native copper, weighing from 50 to 300 lbs., are taken from alongside of this sheet; and the vein stone up to the wall rock is richly charged with copper in its native state."

GOLD PRODUCE OF SIBERIA.

SIR R. I. MURCHISON, in his work, Russia and the Ural Moun-

tains, points the attention of statists and geographers to the Gold Produce of Russia, which may eventually have a very marked influence upon all civilised nations, in changing the relative value of gold as a standard. With very slight exceptions, all the gold sand in the Russian empire had hitherto occurred on the eastern or Siberian side of the Ural, and the gold found had rarely exceeded the annual value of half a million sterling. The reign of the Emperor Nicholas has, however, been distinguished by the important discovery, that portions of the great *eastern* regions of Siberia are highly auriferous, viz., in the governments of Tomsk and Yeniseik, where low ridges, similarly constructed to those on the eastern flank of the Ural, and like them trending from north to south, appear as offsets from the great east and west chain of the Altai, which separates Siberia from China; now, a very few years ago, this distant region did not afford a third part of the gold which the Ural produced; but, by recent researches, an augmentation so rapid and extraordinary has taken place, that, in 1843, the eastern Siberian tract yielded considerably upwards of two millions and a quarter sterling, raising the total gold produce of the Russian empire to *near three millions sterling!*

SILICEOUS MICROSCOPIC SEA ANIMALS IN GUANO.

Professor Ehrenberg has stated to the Berlin Academy of Sciences, that he has examined a Guano, said to be from Africa, although labelled "Pacific Ocean," received from London by Schomburgh; a guano of commerce which had been employed by Professor Henry Rose in his laboratory; a specimen brought by Humboldt from Arica in Peru; and lastly, a sample of the guano of commerce which had been used by Magnus in his laboratory; and that he has found in all the four a large quantity of siliceous marine infusoria, viz., respectively 34, 37, 28, and 26 species, in all 75 distinct species. It would therefore seem that the 0·32 of silica detected in guano by Klaproth in 1827, is derived from these minute animals. —*Jameson's Journal*, No. 80.*

ALIOS OF THE NORTH-WEST OF FRANCE.

Messrs. Fleury and Lalesque have sent to the Academy of Sciences of Paris, various specimens of a vegeto-mineral substance, known in the departments of the Gironde and the Landes under the denomination of *Alios*, and which forms the subsoil of the whole western portion of these two departments. Hitherto, the alios has been regarded as a siliceous sand, united together by a ferruginous cement, and the sterility of the superimposed soils has been attributed to it. The researches undertaken by Messrs. Fleury and Lalesque tend to shew that it is composed of silica and a substance which has all the characters of ulmine, except its solubility in alcohol.—*Jameson's Journal*, No. 80.

* See Year-book of Facts, 1846, p. 193.

EARTHQUAKES IN 1846.

Catania.—Strong shocks of Earthquake were felt on April 22, and continued night and day up to the 28th, when they greatly increased in violence. The panic of the population was extreme: on the 22d, the shocks continued three minutes without interruption: the houses "danced and tumbled from side to side;" and large clefts from roof to base were reft in many of the buildings.

Northern Italy was visited by a severe and extreme earthquake on the 14th March. In the Maremmes and adjoining parts of Tuscany, villages were half destroyed, and the fissures which opened in the several marshes near Lorenzana, overflowing with a dark fluid. Leghorn and Genoa also experienced the shocks, which lasted nine or ten seconds. At Leghorn, houses were not only much injured, but some were thrown down. A letter of the 17th says: "At Volterra, a government prison fell, burying several prisoners. The number of persons killed is stated to be, in all the districts, 38; and 140 wounded, of which 58 seriously. The effects of the shock extended to Pisa. The vaulted roof of the old Church of St. Michael fell at the first shock. The congregation had just left the building after divine service; and the houses of the town were shaken. Several natural phenomena occurred. Spouts of muddy and boiling water sprung out of the earth. A lake was formed in a sunken space of land; and all the villas in the neighbourhood were considerably damaged. The farms and peasants' dwellings more or less suffered on the whole line of the shock. During four days, the earth ceased not to shake at intervals.

M. Pilla, professor of geology at Pisa, has published an interesting account of this Earthquake. After examining the effects of the motion in the principal circle of its action, as well as in its secondary extent, he proceeds to show that the propagation of shock was strongest in the hills of Volterra and Sienna, and more feeble in the secondary parts of the Apennines and the Alps, on account of the different topographical formation and geological construction of both these places. He gives it as his opinion that there was no relation between the earthquake felt in Tuscany and the phenomena which were apparent before and after, in the kingdom of Naples. "On the 14th," says M. Pilla, "the sun arose at Pisa upon a calm and beautiful day. At noon, I was in the Museum of Natural History of the University. In that part of the building, several of the windows open towards the interior of the town. I felt the heat at the time suffocating, which rendered it almost difficult for me to breathe. At one o'clock, the atmosphere was calm, and soon I began to hear a noise, coming as from an easterly direction. The impression it made upon me was as that of a stormy wind approaching the town. It kept increasing, till suddenly the room began to tremble; the vibration was succeeded by violent agitation, in a horizontal direction, accompanied by a fearful noise. I ran to the window, and there I saw a fearful sight. The houses were shaking to and fro in a fearful manner. My head became giddy, and I was obliged to withdraw from the window. Inside the room, the agitation still continued, and the plaster began to fall

from the wall, and the noise was increased by the cries which were heard issuing from the neighbouring houses. Gradually, equilibrium was restored, and everything became quiet. I left the museum, and entered the streets. I went in the direction of the leaning tower of Pisa, and, to my astonishment, found it still standing. I have been told that the manner in which it rocked was fearful to behold. Most of the edifices in Pisa are more or less damaged; the vault of the church of St. Michael is ruined, but without accident of any kind. I think the length of time the principal shock lasted, was about 22 or 23 seconds."

Smyrna.—A dreadful shock of earthquake occurred at Smyrna, at 50 minutes past 5 o'clock, P.M., on the 25th August. The atmosphere was quite calm, but the sea much agitated, and the amazed city as if rolling on its waves. Minarets and houses were thrown down, and others greatly damaged. Several persons were killed, and the wreck and terror throughout was sad to behold. The movement was from north-west to south-east, and continued for nearly a minute: and about the same time, a shock was felt at Mytelene.

Scotland.—On Tuesday night, November 24, at a few minutes before twelve o'clock, a shock of earthquake was felt at Perth, of greater intensity and longer duration than any remembered. The state of the atmosphere at the time was calm and beautifully clear. Early on the previous morning, a very heavy rain had fallen, which had cleared the air, and softened the temperature, and the following day was unseasonably fine and mild; the thermometer standing about 52 degrees. At nine o'clock in the evening, it had fallen to 42 degrees, the barometer indicating 29·50 inches; the greatest cold during the night was 36 degrees, and the barometer slightly inclined to rise, standing next morning at 29·51 inches. The shock is generally described as being rather tremulous than undulating; and, in high tenements, heavy articles of furniture were violently shaken, bells were rung, and crockeryware overturned. Such as were walking at the time, described the ground as shaken under their feet, much like the tremulous motion of steam-boats. The duration of the shock, by all accounts, must have been from fifteen to twenty seconds. Along the line of the Grampians it seems to have been particularly severe. At Crieff, a low rumble, resembling distant thunder, but one which a practised ear could at once detect to be the herald of an earthquake, was heard. For five or six seconds it approached nearer and nearer, and waxed louder and louder—then came a heavy underground knock or two, then a sensible upheaving and downfalling, accompanied by a violent shaking of everything on the surface, and the thunder-like noise continuing for six or eight seconds, and died away in the distance.

VESUVIUS.

On May 9, Vesuvius was gorged to the very brim. Its fires might be seen rising at night like a fiery crest upon its summit; and a stream of lava struggled already down,—but the wells of the neighbourhood were not yet dry.

According to the latest observations of the scientific men charged with the geodesical works of the kingdom of Naples, the height of Vesuvius, at its most elevated point—a point which has undergone no change for many years—the *punta del Palo*, is 1203½ mètres above the mean level of the sea.

ERUPTIONS OF HECLA.

LETTERS from Reikiavik state that the eruption of Hecla had continued at that date, the 13th of April, with unabated fury since the 2nd of September in the previous year. There is no example of such a prolonged phenomenon in the annals of Iceland. Very singular consequences have ensued. The winds have carried the volcanic ashes all over the island; and the cattle were perishing, poisoned by the herbage which they taint and cover. The poison developes itself in singular forms of disease, which are described at length; and it was stated, that if the eruption continued two months longer, all the cattle in the island must be destroyed, or abandoned to death by this strange malady. The eruption is described in fearful characters. The flames from each of the three craters were thrown up to a height of 2,400 fathoms, and their width exceeded that of the greatest river in the island. The lava lay mountains high; and masses of pummice-stone weighing half a ton had been carried a distance of a league and a half. The ice and snow of centuries had all melted in the heat, and overflowed the rivers; and the Rangen, swelled also by the burning lava, left its finny tenants on its shores dead and cooked. Each night, the sky was brilliant with the northern lights.—*Athenæum*, No. 968.

Intelligence received from Reikiavik, dated October 29, states that the eruption of Mount Hecla, which had ceased for some time, had again commenced with great violence.—(See the account of the eruptions of Hecla in 1845, with an engraving, *Year-book of Facts*, 1846, p, 268, and vignette in title-page.)

NEW VOLCANO.

A LETTER, dated Aug. 14th, from Lieut. Barker, of the East India Company's steamer Victoria, states that on that day smoke was observed to issue from the summit of Saddle Island, lat. 15° 7′ N., long. 42° 12′ E. The account adds: "The weather at the time was very squally, with thunder and lightning. Saddle Island is one of a group called Zebayer Islands in the Red Sea, in the direct track of vessels proceeding up and down, and are all of volcanic origin; but there is neither record nor tradition of their having been in active operation. Jibble Seer, in lat. 15° 32′ N., and long. 41° 55′ E., was observed to be smoking when visited by the officers of the Benares, during the survey of the Red Sea, but never since.—*Literary Gazette*, No. 1549,

Astronomical and Meteorological Phenomena.

THE CENTRAL SUN.

At the close of the last meeting, (on the 14th of December) of the Royal Irish Academy, Sir William Hamilton announced that he had just received from Professor Mädler, of Dorpat, the extraordinary and exciting intelligence of the presumed discovery of a Central Sun. Professor Mädler's essay on the subject (*Die Central Sonne*, Dorpat, 1846,) was also exhibited by Sir William Hamilton on the same evening to several members of the Academy. By an extensive and laborious comparison of the quantities and directions of the proper motions of the stars in various parts of the heavens, combined with indications afforded by the parallaxes hitherto determined, and with the theory of universal gravitation, Professor Mädler has arrived at the conclusion that the Pleiades form the central group of our whole astral or sidereal system; including the Milky Way and all the brighter stars, but exclusive of the more distant nebulæ, and of the stars of which those nebulæ may be composed. And, within the central group itself, he has been led to fix on the star Alcyone, (otherwise known by the name of Eta Tauri), as occupying exactly or nearly the position of the centre of gravity, and as entitled to be called the Central Sun. Assuming Bessel's parallax of the star 61 Cygni, long since remarkable for its large proper motion, to be correctly determined, Mädler proceeds to form a first approximate estimate of the distance of this central body from the planetary or solar system; and arrives at the (provisional) conclusion, that Alcyone is about 34,000,000 times as far removed from us, or from our own sun, as the latter luminary is from us. It would, therefore, according to this estimation, be at least a million times as distant as the new planet of which the theoretical or deductive discovery has been so great and beautiful a triumph of modern astronomy, and so striking a confirmation of the law of Newton*.

The same approximate determination of distance conducts to the result that the light of the central sun occupies more than five centuries in travelling thence to us. The enormous orbit which our own sun, with the earth and the other planets, is thus inferred to be describing about the distant centre,—not indeed under its influence alone, but by the combined attraction of all the stars which are nearer to it than we are, and which are estimated to amount to more than 117,000,000 of masses, each equal to the total mass of our own solar system—is supposed to require upwards of 18,000,000 of years for its complete description, at the rate of about eight geographical miles in every second of time. The plane of this vast orbit of the sun is judged to have an inclination of about 84 degrees to the ecliptic, or to the place of the annual orbit of the earth; and the longitude of the

* *See the* data of Le Verrier's discovery, at page iii. of the present volume.

ascending node of the former orbit on the latter is concluded to be nearly 237 degrees.

The general conclusions of Mädler respecting the constitution of the whole system of the fixed stars, exclusive of the distant nebulæ, are the following:—He believes that the middle is indicated by a very rich group (the Pleiades), containing many considerable individual bodies, though at immense distances from us. Round this he supposes there to be a zone, proportionally poor in stars; and then a broad, rich, ring-formed layer, followed by an interval comparatively devoid of stars; and afterwards by another annular and starry space, perhaps with several alternations of the same kind, the two outmost rings composing the two parts of the Milky Way, which are confounded with each other by perspective in the portions most distant from ourselves.

Professor Mädler has acknowledged in his work his obligations, which are those of all inquirers in sidereal astronomy, to the researches of the two Herschels, Sir William and Sir John. The views of Sir William Herschel respecting the relation of our solar system to the Milky Way will naturally recur to the recollection of our readers; and while astronomers are anxiously awaiting the shortly-expected appearance of the complete account of Sir John Herschel's Observations on the Southern Nebulæ, the following passage of a letter, which was written in 1835 by that illustrious son of an illustrious sire, from the Cape of Good Hope, to Sir William Hamilton, may be read with peculiar interest, from the agreement between the views it expresses and some of those to which Professor Mädler has been led. In the letter just referred to (from which an extract was published at the time) Sir John Herschel expressed himself as follows:—

"The general aspect of the southern circumpolar region, including in that expression 60° or 70° of S. P. D., is in a high degree rich and magnificent, owing to the superior brilliancy and larger development of the Milky Way; which, from the constellation of Orion to that of Antinous, is one blaze of light, strangely interrupted, however, with vacant and almost starless patches, especially in Scorpio, near α Centauri and the Cross; while to the north it fades away pale and dim, and is in comparison hardly traceable. I think it is impossible to view this splendid zone, with the astonishingly rich and evenly distributed fringe of stars of the third and fourth magnitudes, which form a broad skirt to its southern border, like a vast curtain, without an impression, amounting to a conviction, that the Milky Way is not a mere stratum, but an annulus; or, at least, that our system is placed within one of the poorer and almost vacant parts of its general mass, and that eccentrically, so as to be much nearer to the parts about the Cross than to that diametrically opposed to it."—*Dublin Evening Post.*

TOTAL ECLIPSE OF THE SUN.

SAGNA LA GRANDE, on the island of Cuba, was the only place where total darkness was produced by the Eclipse of the Sun on the

25th of July. A letter from that place to the *New York Sun*, communicates the observations of Mr. Styles:—

"The eclipse commenced at 9h. 41m. 32 s. A.M., sky clear. As the time of the total darkness approached, all animated nature gave signs of approaching night, man only excepted. The hilarity and mirth of our gay Dons and Senoras gave place to indications of chastened feelings and emotions of awe at this sublime evidence of Almighty power. The slaves abandoned their occupations, and in many cases they might be seen on their knees, worshipping the Great Creator.

"The darkness came upon us gradually, and at seventeen minutes past eleven the sun was totally obscured! There stood the moon, covering the whole face of the sun, and presenting the appearance of a great black ball in the heavens, with rays of light diverging from behind it. The rays gave out a pale aurora-like reflection upon the earth, resembling that cast by the moon when half full. This lasted only fifty seconds, and at a little past 12 the eclipse ended. There was no perceptible change in the thermometer. A few scientific gentlemen from London and Paris, sent out by their respective governments, came to take observations, and were highly pleased with the result, it being altogether favourable.

Beginning of eclipse..........	9h.	42m.	30s.	A.M.
„ darkness........	11	17	0	
End "	11	18	19	
„ eclipse..........	0	59	0	P.M.
Duration of darkness..........	0	0	50	
„ eclipse............	3	18	0	

Fahrenheit's thermometer at commencement, 79°, without any perceptible change during the eclipse, after which, however, it continued to rise for some hours.

DOUBLE COMET.

M. Arago has communicated to the Paris Academy of Sciences, from divers letters, that the Comet of 6¾ years, known in Germany by the name of Biela, but which should be more justly called the comet of Gambart, has presented since its reappearance a very curious phenomenon, first observed by M. Valz, of Marseilles. On the 20th January, the comet appeared with its ordinary aspect; from the 20th to the 27th, the weather did not permit an observation; but on the 27th it was seen to have a double nucleus, exactly as if the nucleus, primitively single, had been divided into two, or as if a second comet had been joined to the first. This phenomenon was observed at Berlin, Altona, and Cambridge; and at Paris on the 6th of February.

Professor Challis, of Cambridge, thus announces the discovery, in a letter to the *Times*:—"On the evening of the 23d of January," he reports, "as I was preparing to observe Biela's comet, I discovered a smaller comet in its immediate neighbourhood, and ascertained, by my observations that evening, that the two comets had the same apparent motion. A double comet is a celestial phenomenon

which, I believe, has never before been witnessed, and cannot fail to arrest the attention of astronomers. It will be a matter of very great scientific interest to determine the relative motions of these two singular bodies, and the nature of the influence they mutually exert on each other."

On Feb. 28th, the following communication was made to the Paris Academy of Sciences:—The double comet has already passed its perihelium; and, since the 12th of February, it is disappearing, following its lengthened orbit like a parabola. Up to the 10th of February, the most southern head of the comet had been by far the most luminous, and the northern head the most pale. From this date these appearances have been reversed. The natural inference is, that one comet revolves round the other, and that they constantly change their place with regard to us. M. Saugur has established the theory of the angular separation of the two nuclei, which increased 8,000 leagues between the 27th of January and the 12th of February. This separation is now at least 30,000 leagues in extent. M. Saugur has calculated the orbits of these two heads, and has discovered that these two orbits are two concentric and similar eclipses. One curious fact remains to be noticed: the most northern head reached its perihelium 4′ 30″ before the other; this explains the increase of the angular separation of the two nuclei.

THE NEBULAR HYPOTHESIS.

PROFESSOR NICHOL has written to the Editor of the *Glasgow Argus*, that the Nebular Hypothesis is no longer tenable. The ground of Sir William Herschel's opinion, he says, was this, that many dim spots existed in the sky whose irresolvability could not be accounted for, without a supposed break in a line of induction that otherwise seemed continuous. The chief of these test spots was the nebula in Orion. Lord Rosse writes me:—"I think I may safely say that there can be little, if any doubt as to the resolvability of the nebula." Referring to unfavourable circumstances, he adds, "All about the trapezium is a mass of stars; the rest of the nebula also abound with stars, and exhibit the characteristics of resolvability strongly marked."

THE WINTER OF 1845-46.

M. ARAGO gives the following information in the *Annual* of the Office of Longitudes for 1846, demonstrating that the mildness of temperature which prevailed during the above winter was not so extraordinary as generally supposed:—"The meteorological state of a given place is far less variable than those would be led to believe who judge by their own personal sensations, by vague reminiscences, and by the state of the crops. Thus, at Paris, the average temperatures of the years oscillate within very narrow limits. The annual average temperature of Paris from 1806 to 1826, inclu-

sive, was from 10° 8-10ths above 0, or zero. The greatest of the 21 annual averages only exceeded the general average by 1° 3-10ths, and the least of the average annual temperatures was only 1° 4-10ths below the general average.

"As far, therefore, as the annual average temperatures are concerned, systematic meteorologists have only to foresee, to predict very slight perturbations. The causes of perturbation will satisfy all phenomena, if they can produce 1° 5-10ths (centigrade) of variation, more or less. It is not the same with the months. The differences between the general and the partial averages amount in January and December to 4 and 5 centigrade degrees. By virtue of these variations, if the extreme temperatures of each month be compared with the average or normal temperatures of all the others, it will be found that the month of January is sometimes as temperate as the average month of March; that the month of February sometimes resembles the second average fortnight of January; that the month of March sometimes resembles the average month of April, or the second average fortnight of January; that the month of April never attains the temperature of the month of May; that the month of May is very frequently, on an average, hotter than certain months of June; that the month of June is sometimes, on an average, hotter than certain months of July; that the month of July is sometimes, on an average, hotter than certain months of August; that the month of August is sometimes, on an average, slightly colder than certain months of September; that the month of September is sometimes, on an average, colder than certain months of October; that the month of October may be, on an average, nearly three degrees colder than certain months of November; that the month of November may be, on an average, five degrees colder than the hottest months of December; and that the month of December may be, on an average, seven degrees colder than January."—*Transl. in the Times.*

An interesting communication on this subject, by Colonel Sabine, appears in the *Philosophical Magazine.* The mean temperature in December, January, and February, exceeded the mean temperature of the same months of 1844-5 by an average of 8°. The winter which, within Colonel Sabine's recollection, most nearly resembled the present, was that of 1821-22; and undoubtedly the resemblance is in many respects very striking. The extension of the Gulf-stream in that year to the coast of Europe, instead of its terminating, as it usually does, about the meridian of the Azores, has been assigned as a cause adequate, Colonel Sabine believes, to account for all the phenomena of that winter. "The warm water of the Gulf-stream spread itself beyond its usual bounds, over a space of ocean which may be roughly estimated as exceeding 600 miles in latitude and 1000 in longitude, carrying with it water several degrees higher than the temperature of the sea in ordinary years in the same parallels."

TREE STRUCK BY LIGHTNING.

A LETTER has been read to the Paris Academy of Sciences, from

M. Boussingault to M. Arago, relative to a Tree struck by Lightning, and which the writer saw and examined after the accident;—its object being to repeat an opinion, which he has frequently expressed, that the belief that the electric fluid leaves behind it a strong odour of sulphur is a vulgar error. He says he was assured by some persons that this tree gave out such a smell; but that, having himself visited it, he was convinced that there was no smell of sulphur, and that the real smell was precisely the same as that in the manufactories where vinegar is distilled from wood. M. Boussingault adds, that in no case has he found a sulphureous emanation from any object struck by lightning.—*Athenæum*, No. 974.

HURRICANE IN NOTTINGHAMSHIRE.

The following phenomenon is recorded by Mr. E. J. Lowe, of Highfield House, in a *Treatise on Atmospheric Phenomena*, just published; to which work the leading meteorologists have contributed. On Sunday, 10th of May, 1846, a very violent Hurricane of dust passed through Nottingham. The day had been sultry, with a shower early in the morning. Many thunder showers about. At 1h. or a little before, a most remarkable hurricane of dust occurred. The dust came down the Derby Road, into Nottingham Market Place, in remarkably dense clouds, which quite darkened the sky; and for 15′, with some slight cessations, the dust came in this violent manner. At times, objects were not visible ten yards distant, and some difficulty occurred in breathing. The Market Place was completely filled with the dust. On inquiry, Mr. Lowe found that the dust came on the roads four miles in this violent manner. Near Beeston, people could not walk, and were obliged to take shelter. The wind was most violent the whole time. At the expiration of this hurricane, a thunder-storm passed over, and rain fell for 15′; then fair.

GREAT STORMS.

July 5 *and August* 1.—The principal phenomena of these two Great Storms are thus recorded in a paper read at the Penzance Natural History Society, by Mr. R. Edmonds, Jun.:—

"The Storm of July must have been felt on the Atlantic on the 4th, as much distant lightning from the S. or S.W. was seen in Mount's Bay before midnight, and continued until between 3 and 4 o'clock of the following morning, when the fierce lightning and thunder from every part of the heavens became truly alarming. As the storm proceeded from Mount's Bay, throughout Cornwall, towards the N.E. and E., it grew more violent and destructive. It reached Exeter between 8 and 9 A.M.; Windsor, between 2 and 3 P.M.; and London, at half-past three. In its progress towards the north of Britain, it was felt throughout Somersetshire between 8 and 9 A.M.; at Leeds, about 3½ P.M.; at Penrith, Dumfries, Ayr, and Glasgow, between 3 and 4 P.M.; at Edinburgh, soon after 5; at Dundee and Argyleshire, about 7; and at Aberdeen shortly after midnight. Thus the storm, as it advanced from Mount's Bay towards the east, moved at a considerably slower rate than in its progress northward.

"In many places, both the lightning and the thunder were continuous during most of the storm. A whirling, fitful, or 'wild kind of wind,' accompanied it, with heavy rain or large hailstones. At Ayr and Maybole, it was preceded by a whirlwind of remarkable violence. At Walsall, a whirlwind tore up trees by the roots.

"The temperature on the 5th of July was unusually high, not only in most parts of England, but on the continent. The thermometer at Frogmore, in the Royal Gardens, stood at 93° in the shade; at Manchester 87°; and at Paris 97½°.

"Before the storm commenced in Kent, one of the largest flights of butterflies ever seen in this country completed its passage from France to England. For many hundreds of yards it quite obscured the sun. 'During the passage, the weather was calm and sunny, but an hour or so after they reached *terra firma* it came on to blow great guns from S.W., the direction whence the insects came.'

"The storm of July was not felt in London and the eastern coasts of Britain so severely as on the western. But the storm of August 1st, which visited the metropolis and other parts of England, was more terrible and destructive than any experienced there since 1809. It commenced at Greenwich at 3h. 10 m. P.M. In the meteorological report from the Observatory, it is stated that at Lewisham the hailstones 'were nearly all as large as pigeons' eggs.' It was felt severely, the same evening, at East Waldon, Leicester, and Nottingham, and before midnight at Southampton and Paris. About 4 A.M. of this day, an extraordinary agitation of the sea was observed by the labourers employed in excavating Penzance Pier, the tide being then about five hours' ebb, and the sea very calm. The water suddenly returned towards the shore to the depth of between one and two feet, and, after an apparent pause, rushed back 'like a river' to its former level; the time occupied in the influx and the reflux, including the time of the water appearing stationary, was about six minutes. The flux and reflux were observed only once.

"In London, the thermometer on this day was 89½° in the shade, and 116° in the sun; the latter being the maximum there for the year; and throughout the previous night it did not descend below 70°: at Paris it was 90° a great part of the day. At Penzance, the nights of the 29th, 30th, and 31st, were the warmest hitherto of the year. Early in the morning of the 30th, a terrific thunder-storm, with heavy rains or hail, occurred in Mount's Bay and throughout Cornwall, and also in Wales and Cumberland, from which time, until after the great storm of the 1st of August, the atmosphere in Cornwall, London, and probably throughout England, was very sultry, and highly charged with electricity, whilst violent thunder-storms were experienced in various places.

"An earthquake shock was felt along the Rhine in the evening of the 29th of July: the moon's first quarter was on the 31st, and the agitation of the sea above described (the result, perhaps, of a sub-marine shock) happened on the 1st of August."

"A Correspondent of the *Athenæum*, No. 980, observes, in the storm of hail on August 1, "not merely were the hailstones of an unusual size,—many of them being between three and four inches in diameter,—but it is evident, from the directions in which the largest amount of damage was done to windows, &c., that the storm must have moved along a curved line from the S.E. towards the W., and then towards the N.E., having, at the same time, an internal motion, or, probably, a series of currents setting from the circumference towards the centre, along its line of direction. In this respect it resembled in a remarkable degree the hurricanes of the tropics; and that it was a circular mass of vapour, passing by a line as nearly as possible in the direction above indicated, will be evident to any person who will be at the labour of examining the accounts given of the localities which have suffered most severely. Although to the east of Gracechurch Street a considerable quantity of hail fell, yet it was remarked that it was more like balls of snow than hail. At Walworth, Kennington, Brixton, and the West End of town, the hailstones were hard masses of ice, whilst at Kew no hail fell. In the neighbourhood of London Bridge, a nautical gentleman observed changes of the wind of a very remarkable character; and he states, that during the storm it blew from every point of the compass. All these facts establish the curvilinear path of the tempest and its internal circulatory movements. The singular forms of the hailstones attracted much attention. There were but few of the larger ones round, and many of them had a distinct crystalline arrangement."

METEOROLOGICAL SUMMARY FOR 1846.

(Communicated by Dr. Armstrong, *South Lambeth.)*

Months.	Temperature.						Atmospheric Variations.			Hygrometer.		Modifications of Cloud.*						
	Fahrenh.		Mean.			Fahr.												
	Max.	Min.	Reaumur.	Centigrade.	De Lisle.	Ext. mon. diff. compared with 1845.	Mean Pressure in inches.	Extreme monthly difference.	Prevailing Currents.	Rain in inches.	Monthly diff. of quantity compared with 1845.	Cirrus.	Cirro-stratus.	Cumulus.	Cirro-cumulus.	Cumulo-stratus.	Nimbus.	Stratus.
Jan. ….	55	20	2·6	3·3	146	2·0—	30·15	+0·30	SW. SE.	2·70	+0·35	*	*	*	:	*	*	
Feb. ….	70	28	7·5	9·4	137	20·0+	29·47	—0·58	NW. SW.	1·24	+0·18	*	*	:	:	:	*	
March ..	58	27	4·4	5·5	141·5	6·0+	30·15	—0·13	SW.	1·50	+1·00		*	*	:	*	*	
April ..	45	32	7·1	8·8	136·5	2·0—	29·57	—0·21	SW. N. NW.	2·50	+2·06		*	*	:	*	*	
May ….	78	41	9·7	12·2	132	3·0+	25·32	—0·68	SW. NW.	1·74	—0·50	:	*	*	:	*	*	
June….	86	50	16·0	19·4	120	8·0+	30·13	+0·04	SW. E.	0·40	—2·12	*	*	*	*	:	:	
July ….	85	48	15·1	18·8	122	6·0+	30·00	—0·06	SW.	1·76	+0·74	:	*	*	*	*	:	
Aug.….	83	63	18·2	22·7	115	13·0+	30·13	—0·03	NE. SW.	2·60	—0·19	:	*	*	:	:	*	:
Sept.….	74	41	11·1	13·8	131	3·5+	30·25	—0·15	NE. SW.	1·82	—0·23	*	*	*	:	:	:	:
Oct. ….	70	38	8·8	11·1	133	6·0+	29·72	—0·98	[SW. NW. SE.	5·5	+4·15	:	*	*	:	:	*	:
Nov.….	60	22	4·0	5·0	143	2·0—	30·37	+1·50	SE. SW.	1·45	—0·79	:	*	:	:	:	*	
Dec. ….	48	18	0·4	0·5	150	10·0—	30·03	+0·23	NW. SW.	1·45	+0·72	*	*	:	*	:	:	

Table of the Winds { N. 13 days. S. 6 days. E. 23 days. W. 18 days. NE. 47 days. SE. 30 days. NW. 56 days. SW. 162 days. } On the remaining days, the wind variable, or none.

The greatest atmospheric pressure, 30·98, on Jan. 9, and 31·00, on March 12; least, 28·60. on Dec. 23. Highest temp. 86°, on June 12, (the warmest June in this century); lowest, 18°, on Dec. 14.——Thunder on April 14; June 20, 23d; July 5, 25: Aug. 1, 2, 5; Sept. 6, 7: that on Aug. 1, continued from 3 to 5, P.M. with terrific fury, and was rendered more awful and disastrous by masses of falling ice, some exceeding an inch in diameter, and abrading pavements. Strong aërial currents on Jan. 18, 19, SE.; Feb. 3, SW.; March 16, W.; April 2, 3, 4, SW.; May 14, 15, N.E.; July 18, SW.; Oct. 9, 10, 21, 22, SW.—Highest tides on Jan. 26, 27, 28, 29, 30, 31, owing to land floods; Feb. 14, 26, 27, 28; March 1, 17, 27, 28, 29; April 12, 13, 14, 15, 16, 26; May 12, 13, 14; Aug. 10; Sept. 7, 8, 9; Oct. 7, 23; Dec. 2, 3, 4, 18, 19.——Fall of snow, on March 20; Dec. 11.——On Dec. 29, at 10½, A.M. was observed in NW., by N. opposite the sun, a cirro-cumulus cloud, arched like the rainbow, dimly exhibiting the prism-colours.

N.B. The quantity of rain, as registered for Aug., is quite independent of the great hail-storm: it having destroyed the gauge.

* The form of cloud of most frequent appearance is denoted by an asterisk; of rarest, by a colon.

GENERAL INDEX.

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